No. 2015-1408

In the

United States Court of Appeals

for the

Federal Circuit

PENTAIR WATER POOL AND SPA, INC. and DANFOSS LOW POWER DRIVES,

Appellants

v.

HAYWARD INDUSTRIES, INC.,

Appellee

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2013-00285

OPENING BRIEF OF APPELLANTS PENTAIR WATER POOL AND SPA, INC. AND DANFOSS LOW POWER DRIVES

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May 4, 2015

CERTIFICATE OF INTEREST

Counsel for Appellants Pentair Water Pool and Spa, Inc. and Danfoss Low Power Drives certifies the following:

1. The full name of every party or amicus represented by me is:

   Appellants, Pentair Water Pool and Spa, Inc.; Danfoss Low Power Drives

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

   Pentair PLC, Danfoss A/S

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me are:

   Pentair Water Pool and Spa, Inc. is not publicly traded. It is indirectly owned by Pentair PLC which is publicly traded. Danfoss Low Power Drives is not publicly traded. It is indirectly owned by Danfoss A/S.

4. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or agency or are expected to appear in this court are:

   Appearing for Pentair Water Pool and Spa, Inc. before the agency, Sughrue Mion, PLLC, Fadi Kiblawi; Quarles & Brady, LLP, Raye Daugherty, Joel A. Austin. Expected to appear for Pentair Water Pool and Spa, Inc. before this

Court - Sughrue Mion, PLLC - Mark Boland, Raja N. Saliba, John B. Scherling, Renita S. Rathinam

Dated: May 4, 2015

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TABLE OF CONTENTS

TABLE OF AUTHORITIES

Cases

Statutes

Other Authorities

STATEMENT OF RELATED CASES

Pursuant to Fed. Cir. R. 47.5, counsel for Appellants, Pentair Water Pool and Spa, Inc. ("Pentair, Inc.") and Danfoss Low Power Drives ("Danfoss Drives") (collectively "Pentair" or "Appellants") state as follows:

(a) No other appeal in or from the same proceeding was previously before this or any other appellate court whether under the same or a similar title; and

(b) Related cases pending before this Court or any other court, are as follows:

Federal Circuit Appeal No. 2015-1409 is from an *inter partes* review ("IPR") of U.S. Patent 7,704,051 ("the '051 Patent") and is a "companion" case that will be heard by the same merits panel. The '051 Patent in Appeal No. 2015-1409 is owned by Pentair. The *inter partes* review was instituted by Appellee Hayward Industries, Inc. ("Hayward") and relates to the same general area of technology – pumps for aquatic applications such as pools or spas – as U.S. Patent 8,019,479 ("the '479 Patent") (661-779) at issue in this appeal (copy included in Addendum).

Additionally, Pentair has alleged infringement of, *inter alia*, the '479 and '051 Patents in an infringement action against Hayward pending in the Eastern District of North Carolina (*Pentair Water Pool and Spa, Inc., et al. v. Hayward Industries, Inc.*, *et al.*, E.D.N.C. Case No. 5:11-cv-00459-D) ("the EDNC

lawsuit")). The district court litigation is presently stayed in view of the '479 and '051 *inter partes* review proceedings as well as *inter partes* reexamination proceedings concerning four other patents involved in the EDNC lawsuit. *See* A60-61.[1]

[1] Although not presently pending before any Court, *inter partes* reexaminations for United States Patent Nos. 7,854,597 ("the '597 Patent"), 7,815,420 ("the '420 Patent"), 7,857,600 ("the '600 Patent") and 7,686,587 ("the '587 Patent") – four of the seven patents Pentair is asserting against Hayward in the EDNC lawsuit – have been instituted at the United States Patent and Trademark Office ("USPTO"). Those reexaminations still are at the administrative level within the USPTO.

JURISDICTIONAL STATEMENT

This is an appeal pursuant to 35 U.S.C. § 141(c) from the final written decision of the Patent Trial and Appeal Board of the United States Patent and Trademark Office ("the Board") entered on November 19, 2014 in *Inter Partes* Review No. IPR2013-00285 (A11-49), copy included in Addendum.

Pentair timely filed a Notice of Appeal on January 16, 2015. This Court therefore has jurisdiction over this appeal under 35 U.S.C.§ 141 and 28 U.S.C. § 1295(a)(4)(A).

STATEMENT OF THE ISSUES ON APPEAL

Whether the Board erred in its determination that Claim 12 of the '479 Patent is unpatentable under 35 U.S.C. § 103(a). More specifically, did the Board err in determining that Claim 12 of the '479 Patent was obvious when it:

a) committed legal error in construing the "priming" / "primed" language in Claim 12 in an overbroad and unreasonable manner, inconsistent with the plain meaning and the intrinsic record; and

b) committed legal error in its conclusion of obviousness by

i. finding that all the limitations of Claim 12 are taught or suggested by the two prior art references, even when combined and under any construction, without an element-by-element analysis and based on a fundamental misunderstanding of the primary reference;

ii. improperly combining prior art where the record fails to provide adequate rationale to support the obviousness of the alleged combination, and / or

iii. combining the prior art to allegedly achieve the limitations of Claim 12, when there would have been no expectation of success, and the combination rendered the primary reference unworkable for its intended purpose; and

iv. effectively augmenting the printed prior art via factual "public use" testimony of Hayward's experts, in violation of the statutory printed publication limitation for *inter partes* review.[2]

STATEMENT OF THE CASE

I. Factual Background Of This Dispute

The EDNC lawsuit filed by Pentair against Hayward alleges infringement of seven patents relate to technologies involving variable speed pumps and controllers for aquatic applications, such as pools or spas. A60-61.

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[2] Pentair does not admit or concede that any aspect of non-obviousness of Claim 12 over the prior art raised below but not asserted in this appeal lacks merit, or that any of the Board's findings not specifically mentioned in this brief are supported by substantial evidence and/or are based on a proper claim construction. However, the *inter partes* review record as a whole fails to provide substantial evidence that supports the Board's decision on the grounds presented herein.

The technologies covered by these patents caused a shift away from traditional fixed speed pumps to "plug and play" variable speed pumping systems for swimming pools and spas that achieve speed, energy optimization and automation. *See, e.g.*, A673, '479 Patent at 1:10-2:10. In the companion appeals, these patents relate to fault detection and protection for priming the pump ('479 Patent) and sophisticated fault protection technology when operating the motor ('051 Patent).

II. Overview Of Aquatic Pumping Technology

Conventional pool and spa pumps used fixed-speed technology (operable at a finite number of predetermined speed settings (*e.g.*, typically high and low speeds)), where the rate of flow of water and energy consumption during operation is constant, but not necessarily optimal from an efficiency standpoint. Limitations on the ability of a fixed-speed pump to adjust to varying parameters and conditions thus required pre-selection of an appropriate size pump for a specific pool or spa that takes into account factors such as the volume and flow rate of water to be pumped, the total head pressure to adequately pump the required volume of water at the correct rate and other operational parameters, including the flow resistance in the pipes. *See* A673 at 1:10-2:10. Pumping requirements can also change with operation of a heater, vacuum cleaner, waterfall or other auxiliary device. *Id.* at 1:28-51.

Variable speed pumps, on the other hand, provide for pumps that readily and easily can be adapted to provide a suitable supply of water at a desired pressure to aquatic applications, irrespective of variations in size, plumbing and environment. These pumps can be variably adjusted during operation in response to changing conditions and demands and / or user input instructions. *See* A673 at 1:65-2:10; A2313-2333, Declaration of E. Randolph Collins, Jr., Ph.D., P.E. at A2321, ¶ 28.

III. The Invention Of Claim 12 Of The ‘479 Patent

The ‘479 Patent generally relates to a “plug and play” pumping system with built-in motor and pump protection – technology that allows the system to monitor properties related to fluid flow and adjust the operation of the motor in response. In particular, Claim 12 of the ‘479 Patent provides a pumping system that determines whether the pump is primed and that indicates a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment.

Pumping systems for aquatic applications, such as pools or spas, require the system to be primed in order to efficiently move water through the system. Actively determining whether the pump is primed at start-up, as opposed to passively priming over time, prevents possible damage to the pump if prime is not achieved within the time allotment as provided by Claim 12. A2321, Collins at ¶ 28; A673 at 1:55-65.

The pumping system of the '479 Patent includes a "means for determining a value indicative of flow rate of water moved by the pump…." A673 at 2:19-21. However, "direct sensing of the pressure and / or flow rate of the water is not performed, but instead one or more sensed or determined parameters associated with pump operation are utilized as an indication of pump performance. One example of such a pump parameter is input power [to the motor]." A675 at 6:26-31.

Claim 12 recites:

> A pumping system for at least one aquatic application, the pumping system comprising:
> a pump; a motor coupled to the pump; and
> a controller in communication with the motor, the controller determining a current flow rate based on an input power to the motor, **the controller *determining* whether the current flow rate is above a priming flow value in order to determine whether the pumping system is primed**, the controller indicating **a priming alarm** if the pumping system **is not primed before reaching a maximum priming time allotment**.

A679 (emphasis added).

In Claim 12, the controller coupled to the pump determines the flow of fluid based on input power to the motor, as opposed to actual measurement of the flow using downstream flow or pressure sensors. This is in line with the disclosure of Danfoss U.S. Patent 6,468,042 to Møller ("Møller") (A694-706), which is

incorporated by reference into the '479 Patent at 6:17-32.[3] A675. Based on the sensed input power to the motor, the controller determines if the flow reaches a preset priming value prior to normal operation. The controller indicates a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment. A679 at Claim 12; A676-77 at 8:47 to 9:3 and 9:19-36.

As such, input power "can give information in the form of current and / or voltage as an indication of power and speed measurement of the pump motor." A677 at 9:7-11. Thus, the '479 Patent is based on "an understanding that operation of the pump motor / pump has a relationship to the flow rate and / or pressure of the water flow that is utilized to control flow rate and / or flow pressure via control of the pump." A675 at 6:48-51.

Claim 12 of the '479 Patent addresses a need faced by anyone who owns a pool that uses a modern variable speed pump – to make sure that the pump is primed with water quickly upon start-up, so that if there is a blockage or lack of water in the pump, expensive components are not burned out by dry running the motor and pump. A677 at 9:29-34.

Specifically, Claim 12 describes the operation when starting a filter mode, as illustrated within the red box of annotated Figure 4A of the '479 Patent:

[3] Møller is relied on in the rejection of Claim 12 and was of record during prosecution of the '479 Patent. *See* A662.

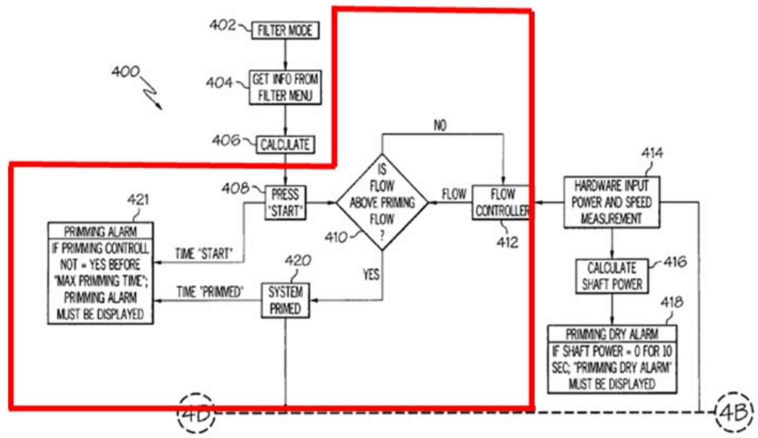

FIG. 4A

A666 (Fig. 4 annotated).

In the only discussion of the Claim 12 pumping system in the specification, after the "start" button (408) is pressed, the controller determines at step (410) if the flow rate is above a priming flow rate. After the "start" button is pressed, the priming alarm step (421) determines if the flow rate is above the priming flow rate within a maximum priming time following start, in which case normal operation proceeds (420). However, if it is determined at step (421) that the flow does not exceed the priming flow value before the maximum priming time has expired, a priming alarm is displayed. A676-677 at 8:47 to 9:3 and 9:18-35.

Accordingly, Claim 12 relates to an intelligent prime determination at start-up, which is particularly advantageous for variable speed pool pumps, which initially run at a high speed to achieve prime and then drop down to a normal operating speed after prime is confirmed. A2321 at ¶¶ 27-28.

IV. Hayward's *Inter Partes* Review Petition And The Board's Rulings

On May 17, 2013, Hayward petitioned for *inter partes* review of the '479 Patent, challenging Claim 12 as being obvious over U.S. Patent 5,819,848 to Rasmuson *et al* ("Rasmuson") (A1145-1156) in view of Møller, as well as numerous other grounds of unpatentability. A54-57. Pentair filed a preliminary response on August 21, 2013, although 37 C.F.R. § 42.107(c) precluded submission of testimonial evidence. On November 20, 2013, the Board instituted *inter partes* review of Claim 12 on the obviousness ground of Rasmuson in view of Møller, but declined to institute review on Hayward's other asserted grounds. A203-224 at A223. Pentair filed a Patent Owner response on February 27, 2014 with supporting expert declarations from E. Randolph Collins, Jr., Ph.D., P.E.[4] (A2313-2333, CV at A1239-1269) and Gary R. Wooley, Ph.D., P.E.[5] (A2334-2347; CV at A1213-1216; A1218-1220). Hayward filed a Reply. An oral hearing

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[4] Dr. Collins has a Ph.D. in Electrical Engineering and is a Professor of Engineering in the Department of Electrical and Computer Engineering of Clemson University; he also serves as an Associate Dean of Undergraduate and International Studies in the College of Engineering and Science at Clemson and as a Provost Fellow. A2314-17 at ¶¶ 2-11; A1239-1269. He has particular expertise in adjustable speed motor drives, electric motors and electronic controllers of these systems. A2317 at ¶ 9.

[5] Mr. Wooley is a registered Professional Engineer with decades of experience in the petroleum industry, including work with surface and subsurface production equipment. A2335 at ¶ 2; A1213-1216; A1218-1220.

was held August 15, 2014, and the Board's final decision was issued on November 19, 2014 (A11-49).

The final decision construes several phrases from Claim 12 of the '479 Patent, which underpin the Board's conclusion that the combination of Rasmuson and Møller renders Claim 12 unpatentable. First, the Board construed the phrases "is primed" and "is not primed" to mean "to describe the primed status of the system at start-up, at restart, or when a loss of prime condition is determined, by comparison of the 'current flow rate' to a 'priming flow rate.'" Second, the Board construed the phrase "maximum priming time allotment" to mean "the period between start-up, restart, or the determination of a loss of prime and the determination that the system 'is primed' or 'is not primed.'" A16-26.

Pentair timely filed its Notice of Appeal on January 16, 2015. *See* 35 U.S.C. § 142; 37 C.F.R. § 90.3(a).

V. The Prior Art Relied On By The Board

In finding Claim 12 unpatentable, the Board agreed with Hayward's position that Rasmuson disclosed all of the features recited in the claim with the exception of "determining a current flow rate based on an input power to the motor." The Board relied on Møller as teaching that input power can be used to determine a pump flow rate. A27-A29.

A. Rasmuson

Rasmuson relates to a downhole pump for pumping well fluids, such as petroleum products. A1150 at 1:6-9. Because of the nature of well fluids, Rasmuson developed control logic for shutting down the motor and pump when flow anomalies occurred and persisted for a predetermined time period. Without shutdown, continued running could lead to pump or motor damage:

> This invention relates generally to pumps that are located downhole within wells for pumping well fluid, typically petroleum products and water, which enter the wells from oil bearing subsurface formations. This invention also concerns an electronic protective system for deenergizing the rotary motor operated drive system of a downhole pump in the event that an abnormally low pump discharge flow exists, which might indicate pump wear, damage or any other pump or pump motor abnormality.

A1150 at 1:6-14.

More specifically, Rasmuson discloses deenergizing the pump motor in the event "abnormally low pump discharge flow is sensed by a flow transducer that continuously measures pump discharge flow at a location immediately adjacent the pump and transmits electrical signals representing pump flow." *Id*. at 1:15-20. Thus, Rasmuson continuously directly monitors the rate of flow discharge using a sensor in the discharge path adjacent to the flow line, and if the flow drops below a preselected operating set point value and persists for preselected time period, the motor shuts down. *Id*. at 1:6-31.

However, Rasmuson's control system does not relate to determining whether the pump is primed at start-up, as claimed in Claim 12 of the '479 Patent. First, Rasmuson's control logic is ***deactivated during start-up***. A1145 (Abstract, last sentence) and A1150-51 at 2:63-3:5; A2328, A2330 at ¶¶ 52, 59; A2340 at ¶ 28. The duration of the start-up deactivation is "selected to permit the well production system to reach its operational characteristics." A1145 at Abstract.

Even if this Court agrees with the Board that Claim 12 covers determinations of prime after start-up, Rasmuson is still not relevant to Claim 12. As explained in the argument, measuring discharge flow rate as in Rasmuson is not determining if the pump is primed or has suffered a "loss of prime." Rather, according to Rasmuson, abnormal ***flow discharge*** sensed in well fluids can be due to: (1) pump wear due to contaminated or abrasive characteristics of the well fluid (destroys pump capability) (2:1-5); (2) excessive load due to fouling or deposits in the pump, which can slow the motor (2:10-14); or (3) generally, conditions that damage the pump or motor, or impair the rotational capability of the pump mechanism (2:26-30). A1150. Additionally, flow conditions of oil wells can temporarily fluctuate due to the presence of gas within the crude oil. Such temporary fluctuations typically dissipate and are not indicative of a flow condition requiring shutting down the pump. A1150 at 1:25-65.

Although entry of gas into the pump can cause a loss of prime and cause flow rate to fall below the set point, Rasmuson's set point is not based on a value associated with system "prime" at start-up, or "loss of prime" during operation. It is apparently just a value selected based on expected flow from a given pump. Rasmuson never discusses "priming," and most of the abnormal flow conditions sensed by Rasmuson would not involve a loss of prime. *See* A2326-29 at ¶¶48-54.

The "motor cut-off logic" disclosed in Rasmuson "permits motor operation of predetermined duration following detection of an abnormal flow rate condition." A1151 at 3:35-37. As clearly stated, the objective of Rasmuson is to shut down the pump for flow abnormalities indicative of pump wear, damage or any other pump or pump motor abnormality and to prevent shutting down the pump because of variations in the gas content of the fluid passing through the pump. A1150-51 at 1:55 to 4:11. Logically, as Rasmuson seeks to prevent shutting down due to a presence of gas, it is not concerned with priming, does not ***determine*** whether a flow is below a priming flow value nor does it indicate a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment.

Thus, Rasmuson not only expects the presence of gas during its normal pumping operation, but seeks to continue its pumping operations in the presence of gas and is designed to avoid detection and shutdown due to the presence of gas (*i.e.*, due to what the Board has characterized as a lack of prime). Notably,

Rasmuson's pump is placed deep in the well below the oil, does not describe any problems with achieving prime and does not even mention the term "prime." A1151 at 4:46-63; A2340 at ¶¶ 25- 29; A2326-29 at ¶¶48-54.

B. Møller

Møller is directed to an improved method for regulating a delivery variable of a pump that compensates for the temperature influence of the motor. A694 at Abstract. Møller teaches measuring the input power of the motor and that the delivery variable can include the flow rate of the pump. A703 at 1:7-9; 1:10-11. Møller is silent as to the initial priming of a pump. A2329 at ¶ 58. Møller limits its scope of applicability to pumping systems described in the Background (A703 at 1:8-63), which employ input power of the motor, as opposed to sensors that directly measure these variables (like the well fluid pump of Rasmuson):

> The invention is based on the problem of ***improving a method of the kind mentioned in the introduction, without direct measurement of the pressure or flow rate of the pump, that is, without using a pressure sensor or flow rate sensor, but using the input power of the electric motor as control variable***, to the effect that the desired operating point of the motor, and hence of the pump, remains stable.

A703 at 1:66 - 2:5 (emphasis added).

SUMMARY OF ARGUMENT

The Board committed legal error by stretching the language of Claim 12 of the '479 Patent to allegedly read on prior art distinct in design, function,

environment and operation. The Board then committed further legal error in its conclusion of obviousness by stretching those prior art disclosures to meet the unreasonably broadened claim language.

The Board found and applied an unreasonably broad construction of the terms “primed,” “priming flow value” and “maximum priming time allotment” in Claim 12. The Board’s constructions go well beyond the plain and ordinary meaning of the terms in light of the ‘479 Patent disclosure, which makes clear that they pertain to the initial start-up of the system. If adopted by this Court, the narrower construction urged by Pentair – which most properly aligns with the intrinsic evidence – is dispositive and requires reversal of the Board.

In the alternative, even under the Board’s erroneous construction, Claim 12 remains patentable over Rasmuson in view of Møller. First, even if the combination of references stands, the “combined” prior art does not disclose each and every element of Claim 12. The Board conducted no element-by-element analysis. At a minimum, the combination does not disclose the claimed pumping system including a controller “***determining*** whether the current flow rate is above a ***priming*** flow value in order to ***determine*** whether the pumping system is ***primed***” and “indicating a ***priming*** alarm if the pumping system ***is not primed before reaching a maximum priming time allotment***.” Rasmuson cannot determine whether the pump is primed or not, but only whether there is abnormal

flow, which can be due to a multitude of reasons, many of which maintain a fully primed pump.

Second, the Board's decision to combine Rasmuson and Møller is fraught with legal errors and findings unsupported by substantial evidence. Highlighting its improper analysis, the Board relied on unsubstantiated, anecdotal testimony by Hayward's witnesses about alleged "prior use" beyond the boundaries of the references themselves. The Board's analysis violated the statutory limitation on *inter partes* review to prior art consisting of patents or printed publications. 35 U.S.C. § 311(b).

Throughout its analysis, the Board committed errors by selectively choosing portions of the references it believed to support its views, while ignoring those portions and, more importantly, the teachings of each reference as a whole, that totally undermine the Board's decision. Likewise, the Board selectively chose Hayward's expert testimony, which impermissibly went beyond the disclosure of the prior art references, while summarily discounting expert testimony that does not support its decision. When the IPR record is properly considered as a whole, Claim 12 should be found patentable under the preponderance of evidence standard.

STANDARD OF REVIEW

"Whether a claimed invention would have been obvious is a question of law, based on factual determinations . . . ." *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013). On appeal, this Court reviews the Board's compliance with the legal standards governing obviousness *de novo* and the underlying factual determinations for substantial evidence. *Id.*

Substantial evidence review "involves examination of the record as a whole, taking into account evidence that both justifies and detracts from an agency's decision." *In re Gartside*, 203 F.3d 1305, 1312 (Fed. Cir. 2000). "Substantial evidence is more than a mere scintilla. It means such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *Id*. (quoting *Consolidated Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938)).

Obviousness is a legal question based on underlying factual determinations, including: "1) the scope and content of the prior art, 2) the level of ordinary skill in the art, 3) the differences between the claimed invention and the prior art, and 4) evidence of secondary factors, also known as objective indicia of non-obviousness." *Eisai Co. Ltd. v. Dr. Reddy's Labs., Ltd.*, 533 F.3d 1353, 1356 (Fed. Cir. 2008); *accord Randall Mfg.*, 733 F.3d at 1362.

Furthermore, "[a] petitioner in an *inter partes* review may request to cancel as unpatentable 1 or more claims of a patent . . . only on the basis of prior art

consisting of patents or printed publications." 35 U.S.C. § 311(b). The Board's action must be set aside as unlawful when it is arbitrary, capricious, an abuse of discretion, unsupported by substantial evidence, or otherwise not in accordance with the law. 5 U.S.C. § 706(2)(A), (E); *In re Sullivan*, 362 F.3d 1324, 1326 (Fed. Cir. 2004).

In its Patent Owner Response, Pentair described one of ordinary skill in the art to be a person that is, among other attributes, an electrical or mechanical engineer having the equivalent of a post-high school education, such as a bachelor's degree in electrical or mechanical engineering with several years of experience in the design of motor drives and pump systems used in aquatic applications. A282-283. Hayward did not contest Pentair's definition.

ARGUMENT

I. The Board Erred In Reaching Its Unreasonably Overbroad Claim Constructions

Each of the Board's constructions is unreasonably broad in light of the '479 Patent disclosure. Under the proper broadest reasonable construction in light of the specification, the language of Claim 12 does not encompass a "loss of prime" determination – *i.e.*, determining the loss of prime from a primed stated. Rather, Claim 12 properly read in light of the specification relates to the determination of prime ***at start-up only***. Because Rasmuson clearly disables its motor cut-off

control ***during system start-up***, applying the proper constructions (prime at start-up) should be dispositive.[6]

A. This Is A *De Novo* Review Of The Board's Broadest Reasonable Interpretation

The Court reviews the Board's broadest reasonable interpretation of the claims and other legal conclusions *de novo*. *Tempo Lighting, Inc. v. Tivoli, LLC*, 742 F.3d 973, 976-77 (Fed. Cir. 2014). Applying this standard, the Court should reverse the Board's interpretations of the "priming" language of Claim 12.[7]

B. Pentair's Interpretation Of The "Priming" / "Primed" Limitations, Which Are Directed To Start-up Of The System, Is The Broadest Reasonable Interpretation

"A claim in an unexpired patent shall be given its broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.300(b). The broadest *reasonable* interpretation of the "priming" / "primed" limitations in Claim 12 should limit the scope to system start-up.

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[6] *See* Section II, *infra*. However, as discussed in Section III below, even under the Board's overly broad constructions, the Board fundamentally misunderstood the prior art and committed reversible error in factual and legal analyses, finding various claim elements present in Rasmuson and combining the prior art references.

[7] As used in discussing Claim 12, "priming" / "primed" and the "priming language" refers to the variations of these terms as recited in Claim 12, in their specific contexts.

Pentair's interpretation is consistent with the language of Claim 12, the '479 Patent specification, the testimony of Dr. Collins and Mr. Wooley and the dictionary definition cited by the Board.

In the final decision (A16-26), the Board made two key, related constructions at issue here:

- First, the Board construed the phrases "is primed" and "is not primed" to mean "to describe the primed status of the system at start-up, ***at restart, or when a loss of prime condition is determined***, by comparison of the 'current flow rate' to a 'priming flow rate.'" A23 (emphasis added).
- Second, the Board construed the phrase "maximum priming time allotment" to mean "the maximum time allowed for the system to prime after start ***or restart or after a loss of prime condition is determined***." A26 (emphasis added).

To frame the issues precisely, Pentair respectfully disagrees with the highlighted language in each construction, which is substantially the same.

The Board committed legal error by construing these terms of Claim 12 to encompass periods of operation of the pumping system *at any time during operation*, as opposed to initial start-up of the system. In doing so, the Board ignored the plain and ordinary meaning of the "priming" claim terms, improperly analyzed the '479 specification and gave undue weight to different phrases used in

independent Claim 13. Specifically, the Board ignored its own dictionary definition, and confused and intermixed the distinct concepts of (a) construing a claim term in light of the teachings of the specification, and (b) reading a limitation from the specification into a claim.

1. The Plain And Ordinary Meaning Of "To Prime"

Claim construction always begins with the claim language. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). Generally, the words of a claim are given their plain and ordinary meaning – the meaning that the words would have to a person of ordinary skill in the art at the time of invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (*en banc*).

Everyone knows that "to prime" something means to prepare it for operation or subsequent action. Painters often lay down of coat of "primer" paint on a surface to be painted. But when the surface gets nicked, no one calls that a "loss of prime," and if touch-up paint is applied, no one calls that "priming." A combustion engine can be "primed" by admitting gasoline into the carburetor, such as squeezing a priming bulb linking a gas can to an outboard motor, or activating the choke lever on a lawnmower. Yet when the engine later conks out while cutting the grass because of a kink in the fuel line or dirty fuel, no one ever calls that a "loss of prime." In other words, you "prime" something at the beginning for subsequent action.

In the field of water pumps like those of the '479 Patent, "to prime" means to prepare the pump for operation by drawing water into the pump. In its decision, the Board stated,

> As we noted, a relevant definition of the verb "to prime" is "to pour or admit liquid into (a pump) to expel air and prepare for action."

A17-18 (quoting Random House Webster's College Dictionary (A2475)).

Thus, applying the dictionary definition, the priming of a pump occurs at the ***beginning*** of operation to "prepare for action." In everyday language, "prepare" basically means ***to make ready beforehand***. After engine start-up, a constant stream of gasoline through the carburetor is not considered "priming" – just normal operation. Likewise, with a pump, after system start-up, the flow of water being drawn into and expelled by the pump is not considered "priming" – just normal flow. The Board failed to give proper weight to the plain meaning of "priming" / "primed" in Claim 12 based on the dictionary definition selected, and gave the terms a meaning far broader than even the dictionary definition on which it relied.

2. The Board Committed Legal Errors In Its Analysis Of The Intrinsic Evidence Regarding The "Priming" Language

a. The Only Use Of The Claim 12 Language In The '479 Specification Is In The Context Of The Start-Up Routine In Fig. 4A

The Board improperly analyzed the intrinsic evidence, and the '479 specification in particular, in finding that Claim 12 does not make clear by its language that the word "primed" should be understood to mean "primed initially"

or "primed at start-up." A21-23. Although the Board noted that the claim language does not specifically mention the term "initial" or "start" (A21), that concept is self-evident from the plain meaning of "to prime" discussed above, which specifically connotes ***preparing*** the pump for action. Thus, the Board erred in its conclusions that the specification "does not express a clear intent to deviate from the plain meaning of the word 'primed'" and that Pentair's constructions are akin to improperly reading "an extraneous limitation appearing in the specification" into the claim. A22-23.

Here, the interpretations applied by the Board rest on broadening limitations never appearing in the specification. It is undisputed that ***no aspect of the intrinsic record uses the terms "loss of prime" or "restart" in discussing the system of Claim 12***. Instead, the terms "maximum priming time" and "priming flow value" first occur and exclusively occur in connection with system start-up, at 8:47 to 9:3, then 9:19-35 (A676-77) (describing Fig. 4A (A666)). This is the initial start-up phase of a water filtering process illustrated by the left side of Figure 4A, as part of the overall filtering process described at 8:35 to 10:44 (A676-77) and Figures 4A and 4B (A666-67). In Figure 4A, following "start" at step 408, step 410 says "***is flow above priming flow?***" and, if the answer is "yes," step 420 says "***system primed***." A666 (Fig. 4A); *see* A677 at 9:19-24. In that case, the system having

reached a primed state proceeds to normal filtering operations. *Id.* Normal filtering operations are described at Figure 4B (A667) and at 9:36 to 10:44 (A677).

As the '479 Patent explains, again with reference to Figure 4A,

> It should be appreciated that steps 408 and 420 provide two bits of information that is utilized within an ancillary step 421. Specifically, step 408 provides a time start indication and step 420 provides a time ***primed*** indication. Within step 421, a determination concerning a ***priming alarm*** is made. Specifically, if priming control (i.e., the system is ***determined to be primed***), is not reached prior to a ***maximum priming time allotment***, a ***priming alarm*** is displayed....

A677 at 9:25-33 (emphasis added). Thus, the left side of Figure 4A and its corresponding description at 8:47 to 9:3 and 9:19-36 are the ***only*** locations in the '479 Patent which use the Claim 12 terms "priming flow," "determine [whether the system is] primed / not primed," "priming alarm" and "maximum priming time allotment." Whether characterized as an example or preferred embodiment, this is the ***only disclosure in the '479 Patent which uses these terms from Claim 12.***

b. The Specification Uses Other Language To Describe Normal Flow, Beyond Initial Priming At Start-Up

Indeed, where the pump system is initially primed and operating at normal filtering conditions, the specification repeatedly refers to monitoring of flow against a "flow reference." Fig. 4B (A667) and 9:36 to 10:44 (A677). In contrast, during the initial priming routine following "start," the specification repeatedly refers to monitoring of the "priming flow value" or "priming flow" – the same

language used in Claim 12. Fig. 4A (A666), 8:65 to 9:3 and 9:19-24 (A676-677). The fact that the specification uses different language to describe flow during start-up versus normal operation militates strongly against the Board's broad interpretation of the claim language. *See Aventis Pharms. Inc. v. Amino Chems. Ltd.*, 715 F.3d 1363, 1373-74 (Fed. Cir. 2013) (specification's different uses of "substantially pure" obviated any requirement for a consistent construction of "substantially pure" for the intermediate and end products); *Toro Co. v. White Consol. Indus., Inc.*, 199 F.3d 1295, 1299 (Fed. Cir. 1999) (claims must be construed in light of the appropriate context in which the claim term is used).

c. Limiting The Scope Of Claim 12 To Start-Up Is Not An Improper "Read-In"

Contrary to the Board's conclusions at A21-23, the specification evidences a clear association of Claim 12's "primed," "priming flow" and "maximum priming time allotment" terms with the initial start-up of the system. Therefore, a broadest reasonable interpretation, where the system is primed at start-up, is an entirely proper interpretation of those claim terms read in light of the specification. This is not improperly reading a preferred embodiment (Figure 4A) into Claim 12, because: (1) the description of Figure 4A is not merely a preferred embodiment – it is the ***only*** discussion of the actual terms used in Claim 12 in the patent; and (2) other terminology ("flow" or "flow reference") are used to describe normal pumping operations, which occur after the initial priming. "Primed," "priming

flow" and "maximum priming time allotment" are never used in the '479 Patent to generically cover normal pumping / filtering operations following initial priming. Different language – merely "flow" in reference to a "reference flow" – describes those modes of operation, and the embodiment of Claim 13, as discussed below, uses different language as well. *See In re Suitco Surface, Inc.*, 603 F.3d 1255, 1260-61 (Fed. Cir. 2010) (reversing Board's claim interpretation for being unreasonably broad, and noting that the Board may not ignore "the specification and teachings in the underlying patent").

Respectfully, the Board did not properly construe Claim 12 in the context of the entire claim taken as a whole and the relevant aspects of the '479 Patent specification. *See Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1250 (Fed. Cir. 1998) (the construction that stays true to the claim language and most naturally aligns with the inventor's ***description*** is likely the correct interpretation). Pentair requests that this Court adopt the broadest reasonable construction of the Claim 12 terms ***in light of the '479 Patent specification*** as set forth by Pentair.

Certainly, when construing claims in light of the specification, care must be taken to avoid improperly importing limitations from the specification into the claims. *Phillips*, 415 F.3d at 1323. While the Board gave lip service to this concept, it erred in finding that Pentair's construction essentially imported "the

single embodiment of the pumping system in Fig. 4A" into Claim 12. A22, A23. Claims should be interpreted in light of the written description, but not beyond its enabling disclosure, because otherwise they would cover inventions or aspects of an invention not disclosed. *See LizardTech, Inc. v. Earth Res. Mapping, Inc.*, 424 F.3d 1336, 1344-45 (Fed. Cir. 2005).[8] A description of a single embodiment does not entitle the inventor to any and all means for achieving that objective. *Id*. A single embodiment will support a generic claim only if the specification reasonably conveys to a person skilled in the art that the inventor had possession of the claimed subject matter at the time of filing and enables the skilled artisan to practice the full scope of the claimed invention. *See id; Phillips*, 415 F.3d at 1321 ("The patent system is based on the proposition that the claims cover only the invented subject matter.").

d. Claim 13 Uses Different Language And Does Not Control

Moreover, the Board's analysis of the intrinsic evidence placed too much weight on the language of Claim 13. A20, 22, 25. Claim 13 is an independent

[8] In *LizardTech*, claim 21 was directed to creating a seamless array of DWT coefficients generically yet, after the reading the patent, this Court concluded that "a person of skill in the art would not understand how to make a seamless DWT generically and would not understand LizardTech to have invented a method for making a seamless DWT, except by 'maintaining updating sums of DWT coefficients'" – the single embodiment disclosed by patentee. 424 F. 3d at 1344-45.

claim directed to a different embodiment of a pumping system, which based on its language and context assumes that an initial primed state has already been achieved. A679. Claim 13 recites at the end that "the controller indicating a priming dry alarm if the shaft power is at least ***approaching zero*** for at least about ten seconds." *Id*. at 14:29-31 (emphasis added). Where the shaft power "approach[es] zero," it must have been at an operating level. *See* A20, lines 1-3.

Claim 13 is derived mainly from the description of the right-hand side of Figure 4A (A666) and the corresponding explanation at 9:5-18 (A677). In those locations, the specification uses the term "priming ***dry*** alarm" as opposed to "priming alarm" in Claim 12.

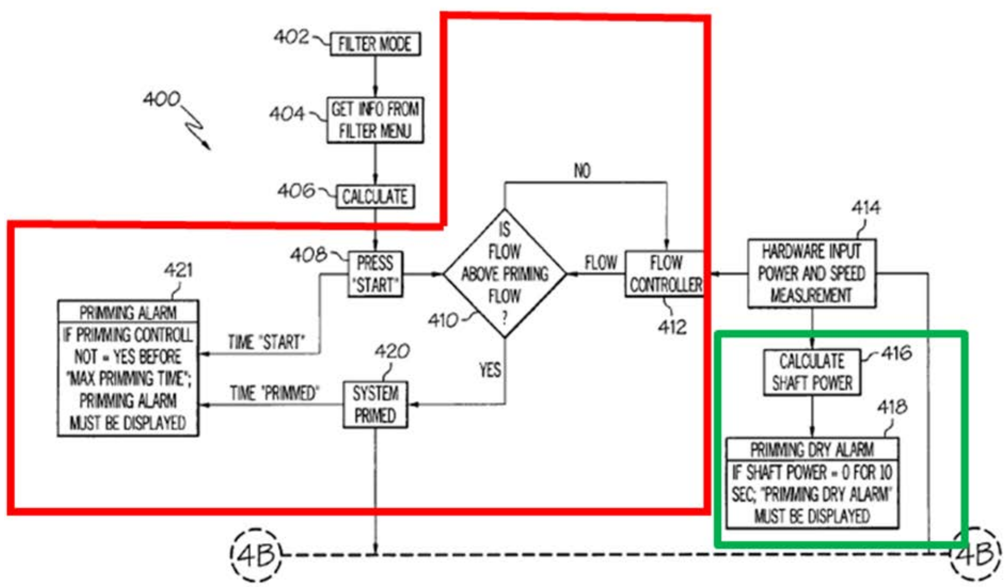

FIG. 4A

A666 (annotated). In the annotated Fig. 4A, the left side (red) depicting start-up is linked to Fig. 4B below it (A667), by an arrow from step (420) – "system primed."

On the other hand, the right side of Fig. 4A (green) is generally linked to Fig. 4B below it (normal filtering operation, using the term "flow reference," as discussed above), without the arrow from step (420) – "system primed." Thus, Fig. 4B and the right side of Fig 4A (green) depict operation following initial system priming, as depicted in the left side of Fig. 4A (red).

Moreover, the claim drafter chose determining "priming status" in Claim 13, as opposed to determining whether the system "is / is not primed" and "priming flow value" and "priming time allotment" in Claim 12. Thus, the language of Claim 13 is not the same as the language of Claim 12, when critically analyzed, and the Board erred in giving Claim 13 significant weight in its Claim 12 construction calculus. *See Aventis*, 715 F.3d at 1373 ("[t]he 'one construction throughout the patent' rule adopted by the district court is incorrect"); *Microprocessor Enhancement Corp. v. Tex. Instruments, Inc.*, 520 F.3d 1367, 1375-76 (Fed. Cir. 2008) (same term may have different constructions within a patent, depending upon the context of how the term is used within the claims and specification). The Board improperly weighted that "variants of the word 'prime' [are used] in each claim," in broadening the scope of Claim 12 to encompass "loss of prime" determinations covered by separate independent Claim 13. A22. In doing so, the Board's analysis was superficial, failing to reflect that the actual terms used in each claim are different, not the same ("priming alarm" vs. "priming

dry alarm," "is primed" vs. "priming status"), and used in different embodiments in the specification. This was clear error under the above authority.

e. Maximum Priming Time Allotment

Although this term is already discussed to some extent above, if the claim terms "is / is not primed" and "priming flow" are construed as relating to the initial start-up phase as Pentair contends, the Board's construction of "maximum priming time allotment" should follow suit, based on the same plain meaning and intrinsic evidence discussed above. The Board's construction (A26) incorporates an unreasonable broadening to include a "loss of prime" determination. The specification of the '479 Patent provides no disclosure to support the scenario where the "maximum priming time allotment" is measured, triggered, or determined by ***a loss of prime***. A2322-25 at ¶¶ 33-34, 36, 39-40. That is, the '479 Patent does not include any explanation as to how the maximum priming time allotment is correlated to a loss of prime. To the contrary, the disclosure of the '479 Patent only describes the maximum priming time allotment in the context of the priming alarm step (421), which is triggered by "start" at step (408). A676-77 at 8:47 to 9:3 and 9:19-35; Fig. 4A (A666). Once the start button is pressed, the priming alarm step (421) implements a repetitive comparison of the flow to the priming flow value until either the flow exceeds the priming flow value or the maximum priming time allotment is exceeded. A677 at 9:19-35.

A "loss of prime" concept centers on prime already having been established and subsequently "lost." To the contrary, Claim 12 begins monitoring the priming status at motor/pump startup and triggers an alarm if prime has not been achieved before a certain period (*i.e.*, the "maximum priming time allotment") has expired. A2323-25 at ¶¶ 35, 37, 40. No broader disclosure exists in the '479 Patent. The Board's decision is silent as to how "loss of prime" condition is determined in context of the '479 Patent after priming alarm step (421) has been initially completed. As noted, a construction which exceeds the written description / enabling support for the claim term at issue is *unreasonably* broad. *See Retractable Technologies, Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296, 1305 (Fed. Cir. 2011) ("In reviewing the intrinsic record to construe the claims, we strive to capture the scope of the actual invention, rather than strictly limit the scope of claims to disclosed embodiments or allow the claim language to become divorced from what the specification conveys is the invention."). Indeed, the rules of the Patent Office require that application claims must "conform to the invention as set forth in the remainder of the specification and the terms and phrases used in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description." 37 C.F.R. § 1.75(d)(1).

C. The Board's Error Affected Its Decision And Requires Reversal

Because the Board's ruling that Hayward established unpatentability depended on the Board's erroneous interpretation of the priming language of Claim 12, the Court should reverse that holding and find Claim 12 patentable, as outlined in Section II below.

II. Under The Proper Claim Constructions, Claim 12 Is Clearly Patentable And The Board's Finding Of Obviousness Should Be Reversed

If "primed," "priming flow value" and "maximum priming time allotment" in Claim 12 are given their ordinary and accustomed meanings in the context of the '479 specification such that they refer to priming the pump at system start-up, Claim 12 is clearly patentable. Rasmuson does not relate to monitoring or control during priming of the pump at start-up – indeed, the control logic for motor shutdown is turned off at start-up. This is clear from the Abstract on the cover page, which states in the last sentence: "The pump motor cut-off logic incorporates a start-up delay which maintains the pump cut-off logic in a deactivated state for a period of time which is selected to permit the well production system to reach its operational characteristics." A1145.

In the body of the patent, Rasmuson does not disclose or teach a controller indicating a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment. Specifically, Rasmuson does not include a controller that checks if the pumping system is not primed during the "start-up

delay period" of Rasmuson. To the contrary, Rasmuson explicitly states that when "pump start or restart occurs it is necessary to disable low flow responsive pump cut-off logic to provide for filling of the production tubing and for pump discharge flow to exist within the flow sensitive transducer." A1150 at 2:63-66. Thus, the Rasmuson system includes "a start-up delay period . . . to provide a field selectable time delay period which must expire after start-up before the pump cut off logic circuitry is activated." A1151 at 3:1-5; A2328, A2330 at ¶¶ 52, 59; A2340 at ¶ 28. In other words, Rasmuson cannot indicate a "priming alarm" before expiration of the start-up delay period. And, as discussed above, Møller is silent about priming at start-up, and is not asserted by the Board or Hayward to provide such teachings.

"[O]bviousness requires a suggestion of all limitations in a claim." *CFMT, Inc. v. Yieldup Int'l Corp*., 349 F.3d 1333, 1342 (Fed. Cir. 2003) (citing *In re Royka*, 490 F.2d 981, 985 (C.C.P.A. 1974)). An obviousness determination requires "a searching comparison of the claimed invention – including all its limitations – with the teaching of the prior art." *In re Ochiai*, 71 F.3d 1565, 1572 (Fed. Cir. 1995). Thus, if this Court narrows the Board's construction of the "priming" language in Claim 12, the Board's conclusion of obviousness should be

reversed, because the "priming" limitations of Claim 12 are not disclosed in Rasmuson.[9]

Other patentable distinctions between Claim 12 and the prior art, *under any claim construction*, are set forth in Section III below.

III. Claim 12 Is Patentable Even Under The Board's Broad Construction

A. The Combination Of Rasmuson and Møller, Even If It Were Proper, Does Not Result In The Invention Of Claim 12[10]

Rasmuson only detects whether discharge flow is lower than a set point. Because *flow* variation in Rasmuson may or may not involve a "loss of prime," Rasmuson's *flow detection* is simply not the same as Claim 12's determination whether the pump "is / is not primed." Rasmuson detects loss of flow where, for example, the pump runs slowly because it is basically pumping sludge, yet the pump is fully primed because Rasmuson distinguishes a slower yet full flow from situations where gas lowers the flow rate. A1150 at 1:25 to 2:30. The Board

[9] Although the Board found Pentair's arguments for patentability under the narrower construction to be moot (A26-27), Pentair respectfully asks for reversal rather than remand in this scenario, since no rational reading of the prior art under the narrower construction can render Claim 12 obvious.

[10] This Court need not reach the issue (discussed in Section III.B below) whether it would have been obvious ***to combine*** Rasmuson and Møller in order to find reversible error in the Board's decision, as even the "combined" prior art system that forms the basis of the Board's decision plainly fails to include all the features of Claim 12.

ignored these and other teachings in Rasmuson, while adopting Hayward's out-of-context passages and incorrect arguments.

A threshold issue fundamental to the Board's conclusion of obviousness is the Board's erroneous adoption of Hayward's argument that Rasmuson discloses all the claimed features, with the exception of "determining 'current flow rate" by use of a flow sensor, rather than determining 'current flow rate based on an input power to the motor.'" A28 (citing Petition at 22). In fact, even if one applies the Board's broad interpretation so that Claim 12 is not limited to start-up operation, Rasmuson remains deficient with respect to several ***additional*** claimed features, including:

- "controller ***determining whether the current flow rate is above a priming flow value*** in order to ***determine whether*** the pumping system is ***primed***, and
- the controller indicating a ***priming*** alarm if the pumping system is not ***primed*** before reaching ***a maximum priming time allotment***.

There simply is ***no evidence***, let alone substantial evidence, to support a finding that Rasmuson teaches an actual ***determination that the pump is / is not "primed,"*** "a ***priming*** alarm," or a "maximum ***priming time*** allotment." The

Board failed to carry out any meaningful element-by-element comparison of these claimed features against the disclosure of Rasmuson.

1. No Substantial Evidence Supports the Board's Reading of Rasmuson As Equating Loss Of Flow With Loss of Prime

a. Hayward Provided No Reliable Evidence

Rasmuson relates to a downhole well pump application that seeks to determine flow anomalies, by comparing a desired flow rate against a set point. Low flow can be due to pump wear, excess load due to fowling or deposits (*e.g.*, "sludge"), or other conditions that could damage the pump or motor if operation continued. Statement of the Case, § V.A and A1150 at 1:65 to 2:29. While Rasmuson also describes that the normal presence of gas in the well can lead to flow anomalies (low flow), it expressly seeks to avoid shutting down due to the presence of gas. A1150 at 1:21-31. Notably, Rasmuson's pump is placed deep in the well below the oil, does not describe any problems with achieving prime, and does not even mention the term prime.[11]

More particularly, Rasmuson states:

> It is well known that the potential flow conditions of oil wells tend to fluctuate significantly and sometimes rapidly ***due to the***

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[11] As Dr. Collins explained, "the pump in Rasmuson is a progressive cavity pump, which is a type of positive displacement pump. Pumps of this type operate very differently than centrifugal pumps in a pool or spa application. For example, they are ***self-priming***. Additionally, in the system of Rasmuson, the pump is flooded (*i.e.*, it is submerged in a well). As a result, the pump would immediately prime upon starting." A2328 at ¶ 51.

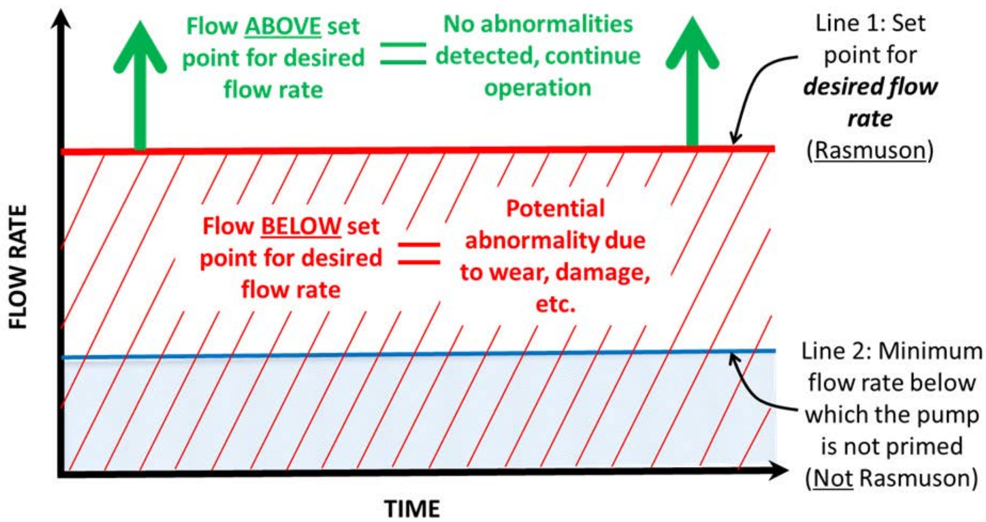
> ***presence of gas within the crude oil*** flowing from the formation. Thus, well pumps that are located in the downhole environment are often subject to ***temporary low liquid discharge resulting from the presence of gas*** that migrates to the well along with the well fluid. Under such conditions the pump will ordinarily be restored to its proper rate of liquid discharge as soon as the excess gas condition is dissipated (typically only a few seconds at a time).
>
> * * *
>
> When conditions occur that impair the rotational capability of the pump mechanism, <u>***regardless of the cause thereof***</u>, ***diminished pump discharge flow will occur***. Thus, according to the present invention it is desirable to continuously sense pump discharge flow and to deenergize the pump or controllably slow pump operation ***in the event pump discharge flow rate should fall below a predetermined set point for*** <u>***any of a number of reasons***</u>. It is desirable that the pump system have the ***capability of accommodating inherent fluctuations in flow measurement without permanently shutting down the pumping operation in response to a flow measurement anomaly that is only temporary***.

A1150 at 1:55-64 and 2:27-39 (emphasis added); *see also id.* at 2:40-62. This disclosure makes perfectly clear that the object of Rasmuson is ***not*** to detect the expected entrapment of gas within the pump that can temporarily effect flow measurement, as such conditions are ***not indicative of abnormalities that can irreparably damage the pump***. Accordingly, Rasmuson implements a delay that is "initiated when the flow related signal becomes less than the selected cut-off signal." A1145 at Abstract. The patent further discloses that "[t]he 'set flow' potentiometer adjusts the set point for the ***desired flow rate*** below which, if the flow remains for longer than a selected period of time," the pump motor is shut down. A1152 at 6:62-67 (emphasis added).

Hayward presented no evidence that reduced flow in Rasmuson is the same as, or even correlated to, a "loss of prime." Therefore, the grounds of rejection should be reversed for this reason alone. In contrast, the IPR record shows that the pump can have (and typically would have) a diminished discharge flow without also losing prime, such as running slowly in heavy fouling due to solid deposits, known as sludge. A1150 at 2:10-14. Stated otherwise, the objective of motor cut-off logic of Rasmuson is not to actually discern the specific cause of the abnormality resulting in reduced discharge flow (*e.g.*, wear, fouling, etc.), but generally to detect the presence of any such abnormality without triggering shut-down of the pump due to the normal and expected presence of gas in the well fluids.

In light of the straightforward disclosure of the Rasmuson patent, neither the Board nor Hayward could even cite to a single disclosure in Rasmuson that supports equating the "set point for the desired flow" to a ***priming*** threshold flow rate. Neither the Board nor Hayward could cite to any actual disclosure in Rasmuson that reasonably could be understood as teaching a determination that the pump is "primed" or indicates a "priming alarm" following a "maximum priming time allotment." ***The Board's Decision is devoid of any such supporting citation to Rasmuson***, relying instead on an alleged "acknowledgement" by Mr. Wooley which, as shown below, was unfounded.

Hayward's Claim Chart 4 in its initial Petition reveals no citation to any actual supporting disclosure in Rasmuson. A82-84. Rather, Hayward confounded the threshold "set point for the desired flow rate" taught by Rasmuson with the concept of a threshold minimum flow rate below which the pump is not primed. As can be illustrated conceptually in the demonstrative below, the two thresholds are unrelated.



In Claim Chart 4 of its Petition, with respect to the claimed feature, "the controller determining whether the current flow rate is above a priming flow value in order to determine whether the pumping system is primed," Hayward cited to Rasmuson at 5:41-61. A82. This location says nothing about priming or priming flow value. Rather, this disclosure refers to "unusually low" flow that can be indicative of an abnormal condition requiring de-energizing the pump. Hayward further cited to Rasmuson at 1:4-20 and 58-64. A83. These portions of Rasmuson,

likewise, refer to abnormal flow conditions, which can be due to pump wear, slowness due to solids / sludge in the pump or other pump or motor abnormality, and contrasts that with normal fluctuations in flow due to the presence of gas in crude oil. Hayward also cited to Rasmuson at 6:62-67 (A1152). A83. Again, this disclosure says nothing about priming or priming flow value, but relates to the hardware for adjusting the "set point for the desired flow rate" – not the priming threshold – below which the pump is de-energized after a predetermined time elapses. Finally, Hayward cited to Rasmuson at 9:26-30 (A1154), which merely describes an LED lighting condition when the pump has been deactivated because the flow rate remained below the "set flow" condition over a period of time. A83. In short, Hayward failed to prove that Rasmuson teaches determining whether the pump is primed or not and then acting on those determinations.

b. Substantial Evidence Does Not Support The Board's Reliance On The Alleged Wooley Admission

Without an element-by-element analysis, the Board instead relied on Hayward's incorrect argument that Pentair's declarant, Mr. Wooley, "acknowledges that Rasmuson teaches priming control during operation." A30-31 (citing Petitioner Reply at 4-5). The Board's unfounded reliance on the alleged admission presents reversible error, and the IPR record as a whole makes clear that Rasmuson fails to disclose any of these claimed features.

At the outset, on the basic issue as to whether Rasmuson teaches ***determining*** whether or not the pump is ***primed***, the Board stated:

> As explained in our Decision on Institution, loss of prime may be due to the presence of too little or too much gas in the pump. Dec. on Inst. 12 (citing Pet. 8); *see* Ex. 1018 ¶¶ 29-30. Although Patent Owner's declarants, Dr. Collins and Dr. Wooley, testify that Rasmuson does not teach determining whether the pump is or is not primed *at start up* (*see* Pet. Reply 5 (citing Ex. 2005 ¶ 27; Ex. 2004 ¶ 48; Ex. 1042 ¶ 28; Ex. 1043, 155:13-19)), Dr. Wooley acknowledges that Rasmuson teaches priming control during operation. Pet. Reply 4-5 (citing Ex. 1042, 153:6-8). Therefore, we are persuaded the activation of the motor cutoff switch due to the presence of too much gas in the flow teaches or suggests a motor shut down due to the loss of prime.

A30-31. In fact, Hayward's allegation – upon which the Board placed heavy reliance – that Mr. Wooley "admits that there is a priming control in Rasmuson; ***just not at start-up***"(A377-378 (citing Ex. 1042, 153:6-8))(emphasis added) – is a clear mischaracterization of Mr. Wooley's actual opinions.

In his declaration testimony, Mr. Wooley begins the discussion of Rasmuson with the heading: "The problem Rasmuson is intending to solve is ***not priming***." A2340. This statement is ***not restricted to start-up of pump operation***, but plainly states that Rasmuson has nothing to do with "priming," period. Naturally, because one of the dispositive issues in the IPR relates to whether Claim 12 is directed to pump control at ***start-up***, Mr. Wooley also specifically opined that Rasmuson is not concerned with priming at this particular stage of pump operation. *See, e.g., id*.

at ¶ 27. However, Mr. Wooley was clear that Rasmuson is not concerned with priming at ***any stage*** of operation:

> It is ***not surprising*** to me that Rasmuson does not mention priming ***anywhere*** in its disclosure. Instead, Rasmuson lists "gas within the crude," "worn pump" and "excessive load" as the flow abnormalities the invention is directed towards. (*See Id.* at 1:55-2:39.) Rasmuson is directed to solving these causes of flow abnormalities and is ***not concerned with priming***.

Id. at ¶ 29 (emphasis added). Thus, contrary to the Board's mischaracterization, ***Mr. Wooley did not limit his opinion to start-up***, but opined that Rasmuson as a whole, including the discussion of pump operation ***after*** startup, is "***not concerned with priming***."

At his deposition, in the context of a discussion concerning priming at start-up (*e.g.*, starting at 151:19), Hayward counsel asked Mr. Wooley a question referring to "priming control that won't happen when the pump is first started" (153:6-7). A1783. Especially in this context, Mr. Wooley's testimony is consistent with not having priming control "anytime," including at start-up. Hayward and the Board, however, now mistakenly twist Mr. Wooley's testimony into a "gotcha" admission when, if anything, this testimony supports Mr. Wooley's position that Rasmuson simply is not concerned with priming. Given the importance Hayward made of its twisted interpretation, its failure to clarify the testimony during the deposition suggests that Hayward either (i) also recognized at the time that it did not support Hayward or (ii) hoped to manipulate potentially

ambiguous testimony out of context. Such testimony plainly does not constitute substantial evidence supporting the Board's decision.

It is noteworthy that Hayward also questioned Pentair's other declarant, Dr. Collins, on the same subject matter. However, Dr. Collins made clear that Rasumson does not deal with or attempt to solve any problems of priming. *See, e.g.*, A1902-1904. Dr. Collins summed up his opinion as follows: "[Rasmuson is] not trying to solve - - ***it's not dealing with priming really at all***." A1904 (emphasis added).

The Board's heavy reliance on the so-called "acknowledgement" by Mr. Wooley in the face of a clear testimonial record to the contrary by ***both*** experts is troubling in its own right, and fundamentally undermines finding substantial evidence to support the Board's decision.

2. No Substantial Evidence Supports The Board's Determination That Rasmuson Teaches A Priming Alarm As In Claim 12

The Board's "combined" prior art system could not indicate "a priming alarm ***if the pumping system is not primed*** before reaching a maximum ***priming time*** allotment." In Rasmuson, comparison of flow with a set point continuously occurs. If the flow drops below the set point, a display is triggered, and then the motor is shut down after a predetermined period if flow has not increased:

> If the rate of fluid flow is unusually low, evidencing a pump discharge flow abnormality, this abnormal condition is immediately

> displayed by the control console and if continuing beyond a preset period of time which is considered safe for the pump and pump drive mechanism, the logic of the control console will deenergize the pump motor so that the pump motor and pump will not be damaged.

A1152 at 5:54-61. Rasmuson is not detecting a "loss of prime," but simply a lower rate of fluid discharge from the pump; second, in Rasmuson the "display" (an LED on the console) is triggered at the *start* of a predetermined length of time (*id*.), whereas in Claim 12 the priming alarm is indicated if the pump is not primed *after* a predetermined time. Rasmuson does change an LED from green to red when the motor is shut down too (A1153 at 8:16-21), but at that point the signal is merely informative as no danger exists. Not only is the "combined" prior art not detecting prime or loss of prime, it also does not signal a priming alarm *after* expiration of a predetermined time period, but rather displays a "low flow" signal at the beginning of one.

Additionally, Rasmuson's LED, which the Board found is an alarm, is an indicator that a *loss of flow* has occurred, which can be due to many conditions discussed above, none of which is an indication of a loss of prime. Accordingly, Rasmuson's LED does not correspond to the recited "priming alarm."

Hayward offered no evidence that Rasmuson actually disclosed the claimed feature, "the controller indicating a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment." Hayward's Claim Chart 4 additionally cited to Rasmuson at 7:29-35 and 8:16 to 9:47 (A1153-54; *see*

A83-84); these disclosures, however, say nothing about priming or priming flow value. At 7:29-35, Rasmuson discusses activation of the cut-off switch only when the flow is below the "set flow" value for a period of time that exceed a delay threshold. At 8:16 to 9:47, Rasmuson discusses the circuit boards and LED hardware consistent with the pump cut-off logic based on flow below the "set flow" value.

Thus, the prior art fails to meet the limitations of Claim 12 on multiple levels, whereas even one claim limitation missing from the prior art mandates a conclusion of nonobviousness. "[O]bviousness requires a suggestion of all limitations in a claim." *CFMT, Inc.*, 349 F.3d at 1342 (citing *In re Royka*, 490 F.2d at 985; *In re Ochiai*, 71 F.3d at 1572 (Fed. Cir. 1995).

3. The Board Ignored All Of Rasmuson's Teachings That Loss Of Flow Can Occur Due To Wear, Sludge, Damage, Etc., Without Loss Of Prime

As explained above, in Rasmuson, a lower flow rate could occur because of many conditions other than "loss of prime" due to excess gas entering the pump during operation. To sum up, Rasmuson expressly describes multiple "low liquid discharge" causes that are not due to the presence of gas in the well fluid:

(1) pump wear due to contaminated or abrasive characteristics of the well fluid, which destroys pump capability (2:1-5);

(2) excessive load due to fouling or deposits in the pump, caused the pump to be slowed (2:10-14); and

(3) generally, conditions that damage the pump or motor, or impair the rotational capability of the pump mechanism (2:26-30).

A1150.

Thus, when the control system senses flow below the set point, it may be due to one of the above conditions (1) to (3), which still involve a "primed" pump in its broadest sense because Rasmuson never discusses gas as causing the low flow in those situations, and no record evidence equates low flow with "loss of prime" in those concrete situations.[12] Rasmuson is not performing what Claim 12 requires: "determine whether the pumping system is primed" and "indicating a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment." Rasmuson just measures flow levels, which can decrease for a variety of reasons.

The Board wholly ignored these undisputed teachings of Rasmuson and made findings based on fundamental misunderstandings of the actual teachings of

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[12] Even if a low liquid discharge results in a persistent loss of prime, the detection and LED system of Rasmuson does not have the ability to ***identify low liquid discharge as being due to an actual loss of prime***. Thus, the Rasmuson system is incapable of "determining whether the current flow rate is above a priming flow value in order to determine whether the pumping system is primed," or of "indicating a priming alarm if the pumping system is not primed."

the prior art. The Rasmuson system, regardless of whether it is combined with Møller, simply cannot tell whether the system is "primed" or not; it can only tell if flow is abnormal, which may or may not be due to presence of gas and even then not necessarily a "loss of prime."

Because the Board's analysis ignored these fundamental teachings of Rasmuson in its findings, they are not supported by substantial evidence, and the legal conclusion of obviousness was erroneous. It is well-settled that a prior art reference must be considered for all that it discloses. "[Section] 103 does not permit a court to stitch together an obviousness finding from discrete portions of prior art references without considering the references as a whole." *In re Enhanced Sec. Research*, LLC, 739 F.3d 1347, 1355 (Fed. Cir. 2014) (citing *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1568, 1577-78 (Fed. Cir. 1987) (reversing the district court's obviousness holding, because it "selected bits and pieces from prior patents" rather than treating the prior art "as whole.")); *Genetics Inst., LLC v. Novartis Vaccines & Diagnostics, Inc.*, 655 F.3d 1291, 1305 (Fed. Cir. 2011) ("Viewed as a whole, the prior art would not have prompted one of ordinary skill to require retention of the a3 region."); *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1550 (Fed. Cir. 1983) (a prior art reference must be considered in its entirety, including portions that would lead away from the claimed invention).

Here, the Board indiscriminately read the unhelpful teachings right out of Rasmuson – fundamentally, the indisputable fact that ***loss of flow***, which can be for many reasons, rather than "loss of prime," is being measured. This was critical legal error. Moreover, because the Board based its decision invalidating Claim 12 on its finding that "Dr. Wooley acknowledges that Rasmuson teaches priming control during operation," and because that finding was clearly erroneous, the Board's decision should be reversed.

B. The Board's Decision To Combine Rasmuson And Møller Was Improper And Riddled With Errors

Claim 12 also calls for using ***input power to the motor*** to assess whether the flow rate is above a predetermined priming flow value, and Møller is cited as disclosing this technique. Whether the issue is characterized as no motivation to combine or whether the addition of Møller's technique defeats the operability, function and/or mode of operation of Rasmuson, several key facts – glossed over by the Board – cannot be disputed.

1. Møller's Technique Does Not Mesh With Rasmuson's Goals And Would Not Work In Rasmuson's Pump System

As discussed in Section III.A above, Rasmuson teaches detection of an abnormal flow discharge rate from the pump using a sensor in the discharge flow line adjacent the pump. The controller and logic in Rasmuson, ***by design***, do not know the ***cause*** of the abnormal flow rate discharge – only that it is reduced and

thus "abnormal" for any number of reasons. These teachings of Rasmuson are clear from the text of Rasmuson and cannot be disputed.

However, when a system uses input power to the motor to determine the flow rate as in Møller (which is incorporated into the '479 Patent (A675 at 6:17-26)), it assumes that the flow rate of water being discharged has a direct correlation with input power to the motor. A703 at 1:8-14 and 2:3-5. Thus, whether the pump is primed in Claim 12 of the '479 Patent can be measured by monitoring input power to the motor, because the resistance or load on the impeller from the presence of the water in the pump creates a reliably measurable variable, which can be monitored and detected by the controller. The aquatic pump of the '479 Patent thus knows that the water to air ratio is the variable affecting input power to load on the motor, and thus whether the pump reaches a predetermined priming flow at start-up (or loses so much water during normal operation that a "loss of prime" occurs).

In Rasmuson, abnormal discharge flow measured by the sensor or transducer located external to the pump, even if adjacent to it, is not correlated with a "loss of prime." Rasmuson's system seeks to shut down the well fluid pump when abnormal flow conditions are present regardless of the reason. *See* A1150 at 1:65 to 2:39. Thus, Rasmuson proposes control logic that directly detects ***low flow***, which Hayward's evidence cannot correlate to a loss of prime threshold, and shuts

the pump motor down after a predetermined time period when detected, regardless of the reason. No broader disclosure is present or argued. An important undisputed fact is that Rasmuson considers excess gas in the pump and excessive load on the motor due to "sludge" in the pump to be on equal footing from a control logic standpoint, where abnormal (lower than optimum / set point) discharge flow results in either case.

However, in the former case of excess gas in the pump, strain or load on the pump and motor ***decreases*** along with decreased flow rate. It is easy to understand that the pump spins more freely in air than liquid or a liquid / solid mixture and requires less motor power. On the other hand, in the latter case of decreased flow rate because of sludge / deposits / solids in the well fluid as Rasmuson describes, the strain or load on the pump and motor ***increases***, as Rasmuson recognizes at 2:10-18 (A1150) ("excessive load").

Møller's system of determining flow rate ***based on input power to the motor*** could never meet Rasmuson's stated goals of motor shutdown when abnormal flow existed beyond the predetermined time. Møller's controller used in Rasmuson could detect ***decreased*** input power to the motor when it dropped below a set point and correlate it to decreased flow, in a water pump. However, such a hypothetical Rasmuson / Møller system monitoring input power to Rasmuson's motor to determine if it decreased below the set point (as Rasmuson does by directly

comparing measured discharge flow rate to the set point), would not detect ***increased*** load on the motor caused by the "sludge" or the like in the pump, as expressly contemplated in Rasmuson. Thus, a person of ordinary skill in the art could not have had a reasonable expectation that Møller's technique would work successfully in Rasmuson's system. *See Par Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1193 (Fed. Cir. 2014) (a party asserting that a patent is obvious must demonstrate that "a skilled artisan would have had reason to combine the teaching of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success from doing so."). In other words, monitoring the ***input power*** to the motor in Rasmuson would tell a Møller-type system that an excess load due to sludge or the like was ***above the flow set point*** – not below as would occur with a "failure to prime" (or even "loss of prime"). Monitoring input power to the motor in Rasmuson would let the system continue uninterrupted, even in excess load situations. This would burn out the motor / pump assembly in short order, as admitted on the face of Rasmuson as quoted above.

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." MPEP § 2143.01(VI) (citing *In re Ratti*, 270 F.2d 810, 813 (CCPA

1959)). Rasmuson compares directly measured discharge flow against a predetermined set point, to see if it dips below the set point for a predetermined time, and the motor is shut down if the time is exceeded. If flow was measured as in Møller by comparing input power to the motor against a predetermined set point, to see if it dips below the set point for a predetermined time, it would fail to measure abnormal flow due to *excess loads*, as discussed above.

Any other way of modifying Rasumson would be a fundamental change in the principle of operation of Rasmuson and thus run afoul of these basic tenets. *See, e.g., Plas-Pak Indus., Inc. v. Sulzer Mixpac AG*, No. 2014-1447, 2015 WL 328222, at *2-3 (Fed. Cir. Jan. 27, 2015) (affirming the Board's determination of non-obviousness where combining the prior art references would fundamentally alter the primary reference's principle of operation); *In re Gardner*, 449 F. App'x 914, 916 (Fed. Cir. 2011) (recognizing that "if a proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious").

Additionally, if the "proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP § 2143.01(V) (citing *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984)). This is

exactly the case here. ***When the measure of decreased flow rate versus a set point in Rasmuson is based on input power instead of direct measurement, the excess load situations would not be detected, and abnormal flow would continue unabated.*** Thus, based on the disclosures of the prior art without more, a person of ordinary skill in the art would not have used Møller's indirect flow measurement techniques in Rasmuson because they would not have worked.

Any pumping system introducing sludge and solids into the pump, as Rasmuson states unqualifiedly is a primary concern (A1150 at 2:10-14), cannot realistically operate with Møller's "input power" monitoring technique, in the context of the '479 Patent. *See Plas-Pak Indus., Inc.*, *supra*, 2015 WL 328222, at *4 (affirming Board's finding that a person of ordinary skill in the art would not combine the asserted prior art, where doing so would render the primary reference inoperable for its intended purpose); *McGinley v. Franklin Sports, Inc*., 262 F.3d 1339, 1354 (Fed. Cir. 2001) ("If references taken in combination would produce a 'seemingly inoperative device,' we have held that such references teach away from the combination and thus cannot serve as predicates for a *prima facie* case of obviousness.") (quoting *In re Sponnoble*, 405 F.2d 578, 587 (C.C.P.A. 1969)); *see also Tec Air, Inc. v. Denso Mfg. Michigan Inc*., 192 F.3d 1353, 1360 (Fed. Cir. 1999) (same).

Thus, because the proposed combination of references cannot render the claims obvious as a matter of law, the Board's obviousness determination is erroneous and must be reversed.

2. The Board's Reliance On Hayward's "Prior Use" Declarations Dooms Its Analysis

When confronted with Pentair's evidence, based on the text of the cited references in the relevant time frame, the Board erroneously relied on anecdotal and unsubstantiated evidence in Hayward's declarations to "bridge" the gaps in the art and make the combination, stating:

> Further, as noted above, Petitioner's declarants, Dr. Emadi, Dr. Toliyat, and Dr. Schaaf, have testified persuasively that measurement of power input is and has been an accurate proxy for flow transducers to detect loss of prime. *See, e.g.*, Ex. 1018 ¶¶ 24–25 [A1033]; Ex. 1037 ¶¶ 27–29 [A1497-1498]; Ex. 1038 ¶¶ 17–19 [A1582-1584].

A36 (appendix cites added in brackets).

Indeed, as one example, Mr. Schaaf basically gave fact testimony – expressly credited and relied on by the Board – about his alleged work for Chevron, at the "Montebello Oil Field." A1582-1584. However, whereas testimony about some aspect of Rasmusen's disclosure can be a proper subject for expert testimony, the Board's reliance on fact testimony relating to alleged prior public use, barred by statute, was clear legal error, prejudicial, and tainted the analysis and conclusion. Therefore, the agency action should be set aside as

contrary to the law. *See In re Sullivan*, 362 F.3d at 1326 (Fed. Cir. 2004) (This Court sets aside "actions of the Board that are arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law. . . ."). The rejection is based on Rasmuson in view of Møller, not the Montebello Oil Field.[13]

First, the finding – critical to the conclusion of obviousness – fails to squarely address the fundamental issue that using input power to determine loss of flow cannot work with Rasmuson's system, where loss of flow can be due to sludge or damage in the pump and an ***excess*** load on the motor, as discussed above.

Second, the Board elevated the Hayward "public use" testimony to a level which ***augmented*** the prior art relied on. This was clear legal error in the Board's analysis. The statute governing *inter partes* review expressly provides that prior art is based on patents or printed publications: "A petitioner in an *inter partes* review may request to cancel as unpatentable … claims of a patent … only on the basis of prior art consisting of patents or printed publications." 35 U.S.C. § 311(b).

[13] Although the Board denied Pentair's motion to exclude evidence concerning the Toliyat and Schaaf declarations, and several patent references cited in the Toliyat declaration, holding that Pentair's objections go to weight and not admissibility (A42-48), the Board's obviousness analysis shows that it gave considerable weight to alleged facts, not opinions, in these declarations. The Board's reliance on those "facts" concerning alleged prior public use (and any citations to other patents) to supplement the art at issue constituted clear legal error.

The Board's reliance on Hayward's fact testimony to erroneously supplement the teachings of straightforward prior art documents is reversible error. The scope and content of the prior art was illegally expanded beyond that permitted by statute.

Third, the Hayward declarations relied on by the Board at A36 to "bridge" Rasmuson and Møller were bald and conclusory and never explained where ***in Rasmuson or Møller loss of prime is detected***.

All of these undisputed facts undermine the Board's analysis. The combination of references as adapted by the Board, relying on inadmissible "public use," cannot stand.

3. No Teachings In The References Themselves Would Have Suggested The Combination

Virtually all patented inventions comprise a combination of several claim limitations. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418-19 (2007) ("claimed discoveries almost of necessity will be combinations"); *Envtl. Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 698 (Fed. Cir. 1983). A claimed combination is not obvious if there was no "reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." *KSR*, 550 U.S. at 418. A claim cannot be held obvious without considering the combination of features in the manner claimed. *Id*. ("a patent composed of several elements is not proved obvious merely by demonstrating that

each of its elements was, independently, known in the prior art"); *Ruiz v. A.B. Chance Co.*, 357 F.3d 1270, 1275 (Fed. Cir. 2004).

In analyzing Claim 12, the Board failed to heed these principles and focused on a theoretical combination of features, instead of considering the significant drawbacks and teachings ***within the references themselves*** that would have precluded the combination from the perspective of a person of ordinary skill in the art. The Board improperly focused only on "gas" in the Rasmuson pumps, to the exclusion of other conditions, which create excess load on the motor. Also, merely because Møller is incorporated into the '479 Patent as a useful technique for measuring flow or pressure variables in a *water pump*, a person of ordinary skill would not have ignored Møller's express teaching that it is inapplicable to pumping systems (like the well fluid pump of Rasmuson) that employ sensors to measure these variables:

> The invention is based on the problem of ***improving a method of the kind mentioned in the introduction, without direct measurement of the pressure or flow rate of the pump, that is, without using a pressure sensor or flow rate sensor, but using the input power of the electric motor as control variable***, to the effect that the desired operating point of the motor, and hence of the pump, remains stable.

A703, Møller at 1:66 to 2:5 (emphasis added). Thus, because Møller expressly disassociates his teachings from direct measurement systems (such as Rasmuson), the Board's perceived motivation to combine came not from the references

themselves, but from Hayward and / or the '479 Patent. *See Heidelberger Druckmaschinen AG v. Hantscho Commercial Prods., Inc.*, 21 F.3d 1068, 1072 (Fed. Cir. 1994) ("The motivation to combine references can not come from the invention itself.").

Therefore, Claim 12 would not have been obvious. *See Vizio, Inc. v. U.S. Int'l Trade Comm'n*, 605 F.3d 1330, 1342-43 (Fed. Cir. 2010); *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1316 (Fed. Cir. 2009) (affirming nonobviousness where the cited reference was found "to be lacking at least one of the limitations" and "no sufficient reason existed to modify the prior art" to arrive at the claimed invention).

IV. Pending Appeals To This Court Could Affect The Outcome Of This Appeal

Certain pending appeals from Patent Office AIA proceedings, such as IPRs and covered business method ("CBM") reviews, have asserted that the broadest reasonable interpretation claim construction standard applied at the administrative level based on 37 C.F.R. § 42.300(b) is *ultra vires*, and that the standard enunciated in *Phillips*, 415 F.3d at 1312-19 governs claim construction. *See Versata Development Group, Inc. v. SAP America, Inc. et al*, Appeal No. 2014-1194, supported by numerous *amici*.

Further, in pending Appeal No. 2014-1771, *Ethicon Endo-Surgery, Inc. v. Covidien LP*, Ethicon has asserted that it was error for the same three-member

Board panel to both institute and finally decide the IPR proceeding given that the AIA provides for a different decision-maker for each determination. While Ethicon's argument is based on statutory construction and constitutional grounds (violation of due process), its position is motivated by the same sequence of events that occurred here – a panel of three judges reviewed Hayward's petition seeking institution of an IPR, credited the hearsay declaration of Hayward's expert without hearing testimonial evidence from Pentair, wrote a detailed opinion concluding that Hayward had a reasonable likelihood of prevailing, and ordered the institution of an IPR. Only after that one-sided decision did the same panel conduct an IPR "trial" and render a final determination on the merits – unsurprisingly, in Hayward's favor again. Here, that structurally flawed process led to legal errors in the obviousness analysis and confirmed that the Board essentially prejudged the outcome of this case based on Hayward's one-sided evidence submitted before institution.

CONCLUSION

For the foregoing reasons, the finding of the Board that Claim 12 of the '479 Patent is unpatentable over Rasmuson in view of Møller should be reversed.

Dated: May 4, 2015

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ADDENDUM

ADDENDUM TABLE OF CONTENTS

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Paper 47
Entered: November 19, 2014

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HAYWARD INDUSTRIES, INC.,
Petitioner,

v.

PENTAIR WATER POOL AND SPA, INC.,
Patent Owner.

Case IPR2013-00285
Patent 8,019,479 B2

Before STEPHEN C. SIU, BRIAN J. McNAMARA, and
JAMES B. ARPIN, *Administrative Patent Judges.*

ARPIN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Hayward Industries, Inc. (“Petitioner”) filed a Petition requesting *inter partes* review of claim 12 of U.S. Patent No. 8,019,479 B2 (Ex. 1001, “the ’479 Patent”). Paper 1 (“Pet.”), 1. Pentair Water Pool and Spa, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 5 (“Prelim. Resp.”). On November 20, 2013,

we issued a Decision on Institution (Paper 8, "Dec. on Inst."), instituting *inter partes* review of claim 12 on a single ground of unpatentability. Dec. on Inst. 21. Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 19, "PO Resp."), and Petitioner filed a Reply (Paper 28, "Pet. Reply") thereto.

Petitioner filed a Motion for Observations (Paper 33) on the cross-examination testimony of Petitioner's own declarants, Hamid Toliyat, Ph.D., P.E., and Mr. Robert Schaaf; and Patent Owner filed Observations (Paper 35) on the cross-examination testimony of Petitioner's declarants. Patent Owner filed a Response to Petitioner's Motion for Observations (Paper 38), and Petitioner filed a Response to Patent Owner's Observations (Paper 40).

The parties requested and appeared at an oral hearing before the panel on August 15, 2014. The record includes a transcript of the hearing. Paper 46 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73, addresses issues and evidence raised during trial. For the reasons that follow, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claim 12 of the '479 Patent is unpatentable.

A. The '479 Patent

The '479 Patent generally relates to pumping systems including pumps, motors for driving pumps, and controllers for "control[ling] a pump, and more particularly, [for] control[ling] a variable speed pumping system for a pool, a spa, or other aquatic application." Ex. 1001, col. 1, ll. 10–12. More specifically, the invention at issue in the present petition relates to a motorized pump having a controller performing certain logic operations for identifying whether a fault has occurred relating to the priming of the pump. *Id.* at col. 8, l. 47–col. 9, l. 17; *see* Pet. 5; Prelim. Resp. 2. As recited in claim 12, a pumping system comprises a

pump, a motor coupled to the pump, and a controller. Ex. 1001, Claim 12. The controller determines a current flow rate based on an input power to the motor and on whether that current flow rate is above a priming flow value, in order to determine whether the system, e.g., the pump, is primed. *Id.*; *see* Prelim. Resp. 2. If the pumping system is not primed before reaching a maximum priming time allotment, the controller indicates a priming alarm. Ex. 1001, Claim 12.

The operation of a controller of a pumping system, as recited in the challenged claim, is illustrated by the flow chart depicted in Figure 4A of the ’479 Patent, reproduced below:

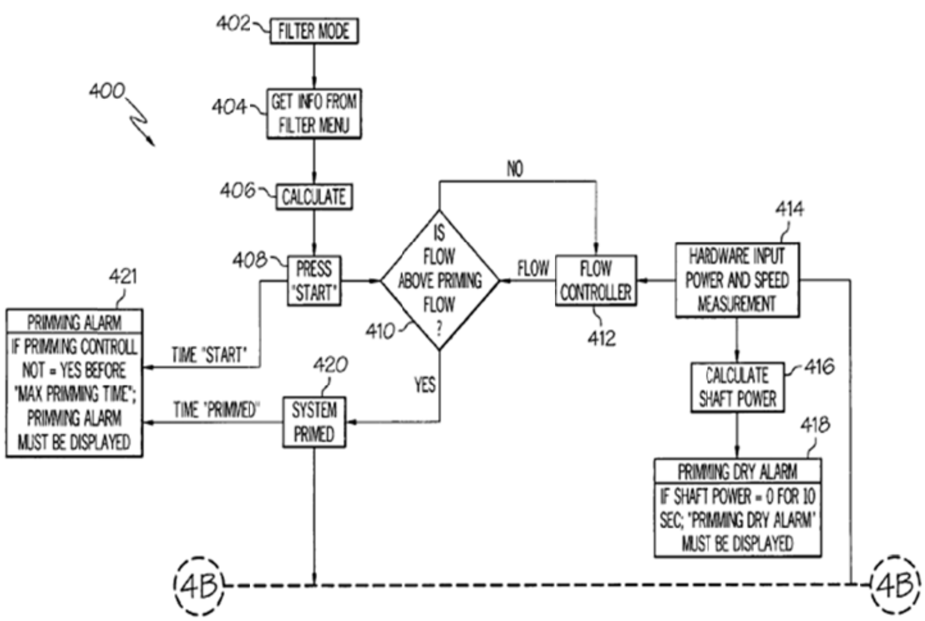

FIG. 4A

In Figure 4A of the ’479 Patent, a flow chart depicts an example of process 400 for accomplishing a filter function within a filter mode for effective filtering of aquatic application 14 or 114, e.g., a pool. Ex. 1001, col. 8, ll. 35–42; *see* Ex. 1001, Figs. 1 and 2. As depicted in Figure 4A, process 400 is initiated at step 402, at which a “filter mode” is selected, and proceeds to step 404, at which filtering

information for the aquatic application is retrieved. *Id.* at col. 8, ll. 47–49. For example, the filtering information may include a value for a maximum priming time. *Id.* at col. 8, ll. 49–54. Next, process 400 proceeds to step 408, in which “START” is activated to begin cyclical operation of the filter mode. *Id.* at col. 8, ll. 62–64.

Process 400 then proceeds from step 408 to step 410, in which it is determined whether a current flow rate of the operating pump is *greater* than a priming flow value. *Id.* at col. 8, ll. 65–67. If the determination at step 410 is that the flow is *not greater* than a priming flow value, process 400 proceeds to step 412. Within step 412, a flow control process is performed in which information is provided via a hardware input, for example, in a form of current and/or voltage as an indication of power output and speed measurement of the pump motor. *Id.* at col. 8, l. 67–col. 9, l. 11. Step 416, in which a shaft power provided by the pump motor is calculated, is associated with step 414. *Id.* at col. 9, ll. 11–13. Further, at step 418, a priming dry alarm step is provided if, for example, the shaft power is zero for ten seconds. *Id.* at col. 9, ll. 13–17.

After step 412, process 400 returns to step 410, at which it is determined again whether the current flow rate is greater than a priming flow value. *Id.* at col. 9, ll. 19–22. If the current flow rate is greater than the priming flow value, process 400 proceeds from step 410 to step 420, indicating that the pumping system is primed. Steps 408 and 420 provide two pieces of information that may be utilized in step 421. Specifically, “step 408 provides a time start indication and step 420 provides a time primed indication.” *Id.* at col. 9, ll. 27–28. Within step 421, process 400 determines whether the pumping system is primed prior to expiration of a maximum priming time allotment. *Id.* at col. 9, ll. 28–32. If not, a priming alarm is displayed. *Id.*

B. Illustrative Claim

Independent claim 12 is the sole claim challenged by Petitioner and is reproduced below:

> 12. A pumping system for at least one aquatic application, the pumping system comprising:
>
> a pump;
>
> a motor coupled to the pump; and
>
> a controller in communication with the motor, the controller determining a current flow rate based on an input power to the motor, the controller determining whether the current flow rate is above a priming flow value in order to determine whether the pumping system is primed, the controller indicating a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment.

C. References, Declarations, and Depositions

Petitioner and Patent Owner primarily rely upon the following references, declarations, and depositions:

Exhibit	References, Declarations, and Depositions
1003	US 6,468,042 B2 to Møller (Ex. 1003 or "Møller '042")
1018	Declaration of Ali Emadi, Ph.D.
1021	US 5,819,848 to Rasmuson (Ex. 1021 or "Rasmuson")
1037	Declaration of Hamid Toliyat, Ph.D., P.E.
1038	Declaration of Robert Schaaf
1039	US 4,021,700 to Ellis-Anwyl ("Ex. 1039" and/or "Ellis-Anwyl")
1040	US 4,473,338 to Garmong ("Ex. 1040" and/or "Garmong")
1041	US 4,767,280 to Markuson ("Ex. 1041" and/or "Markuson")
1042	Deposition of Gary R. Wooley
1043	Deposition of E. Randolph Collins, Ph.D.
1044	Deposition of Hamid Toliyat, Ph.D., P.E.[1]
1045	Deposition of Robert Schaaf[2]
2004	Declaration of E. Randolph Collins, Ph.D.

[1] Also filed as Ex. 2011.
[2] Also filed as Ex. 2010.

2005	Declaration of Gary R. Wooley

D. Ground of Unpatentability

This *inter partes* review involves the following ground of unpatentability:

References	Basis	Claim
Rasmuson and Møller ’042[3]	35 U.S.C. § 103(a)	12

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, "[a] claim in an unexpired patent shall be given its broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b); *see also Office Patent Trial Practice Guide*, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012) (*Claim Construction*). Under the broadest reasonable construction standard, a claim term is presumed to have an ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). A patentee may act as his or her own lexicographer by providing a special definition for a claim term in the specification with "reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Generally, in the absence of such a special definition or other considerations, "limitations are not to be read into the claims from the specification." *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

In our Decision on Institution, we provided constructions for various terms of the challenged claim. Dec. on Inst. 9–16. In particular, we construed the verb

[3] The order of these references is not determinative of our decision. Dec. on Inst. 20 (citing *In re Bush*, 296 F.2d 491, 496 (CCPA 1961)); *see* Pet. Reply 13–14.

phrases "is primed" and "is not primed" to describe the primed status of the system at start-up, at restart, or when a loss of prime condition is determined, by comparison of the "current flow rate" to a "priming flow rate." *Id.* at 16. Further, we construed the "maximum priming time allotment" as the period between start-up, restart, or the determination of a loss of prime and the determination that the system "is primed" or "is not primed." *Id.* Similarly, we construed the "maximum priming time allotment" to mean the maximum time allowed for the system to prime after start or restart or after a loss of prime condition is determined. *Id.*

Patent Owner argues that our constructions of these "prime" related terms are unreasonable and inconsistent with the Specification of the '479 Patent. PO Resp. 1, 5, 15. In particular, Patent Owner argues that we "did not properly construe portions of Claim 12 in the context of the entire claim taken as a whole and the relevant '479 Patent specification." *Id.* at 6.

1. "Is Primed" and "Is Not Primed"

Patent Owner argues that each of our constructions of the "prime" related terms incorporates an unreasonable broadening to include a "loss of prime" determination. *Id.* at 8. Further Patent Owner argues that, "[u]nder the proper broadest reasonable construction, the [language] of Claim 12 does not encompass the 'loss of prime' determination scenario interjected by the preliminary construction offered by the Board." *Id.* (citing Ex. 2004 ¶¶ 33–34, 36, 39–40).

In our Decision on Institution, we noted that the Specification of the '479 Patent does not define expressly the verb "to prime" or the adjective "priming." Dec. on Inst. 11. Patent Owner does not contest this, nor does Patent Owner identify an express definition of these terms in the Specification. As we noted, a relevant definition of the verb "to prime" is "to pour or admit liquid into (a pump)

to expel air and prepare for action." *Id.* (quoting RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY 1047 (2d Random House ed. 1999) (Ex. 3001)).

Nevertheless, Patent Owner argues that

> The Board's construction of the root word "prime" is fundamentally flawed to the extent that it is founded in the erroneous "loss of prime" concept, which is not applicable to the language of Claim 12. The "loss of prime" concept centers on prime already having been established and subsequently "lost." In other words, the baseline assumption is that prime existed before the subsequent loss of prime. *To the contrary, Claim 12 begins monitoring the priming status at motor/pump startup and triggers an alarm if prime has not been achieved before a certain period (i.e., the maximum priming time allotment") has expired.*

PO Resp. 9 (citing Ex. 2004 ¶¶ 35, 37, 40) (emphasis added).

Patent Owner argues that the word "prime," as used in claim 12, must be understood in terms of the depiction of an embodiment of a pumping system in Figure 4A of the '479 Patent, reproduced above. *See supra* Sec. I.A. We agree that claim terms must be construed in the context of and consistent with the disclosure in the specification, and we have done that here. Referring to Figure 4A, we determined that, "[i]f the current flow rate is greater than the priming flow value, process 400 proceeds from step 410 to step 420, indicating that the pumping system is primed." Dec. on Inst. 6. Patent Owner maintains, however, that once process 400 proceeds to step 420, process 400 logically will not employ priming alarm 421, unless and until step 408, i.e., the "PRESS 'START'" step, of process 400 is performed. PO Resp. 9–10. In other words, once process 400 determines via priming alarm 421 that the pump is primed, the primed state of the pumping system persists, unless priming dry alarm 418 is triggered. *Id.* at 10.

Patent Owner argues that, given a proper contextual understanding of the phrase "the controller determining whether the current flow rate is above a priming

flow value in order to determine whether the pump system is primed" in view of the Specification, the phrase should be construed as describing *only* the *initial* priming control. *Id.* (emphasis omitted). Specifically, and in connection with Figure 4A, Patent Owner argues that the controller repeatedly compares the current flow rate to a priming flow. *Id.* (citing Ex. 1001, col. 9, ll. 19–35 ("the process 400 returns to step 410 in which the query concerning the flow being above a priming flow is repeated")). Therefore, Patent Owner argues that this phrase is construed properly to require that priming alarm step 421 is performed repeatedly *after* step 408 ("PRESS 'START'") until priming alarm step 421 has determined either that the system is primed or that the maximum priming time allotment has been exceeded, after which "a priming alarm is displayed, and the process 400 is interrupted and does not proceed any further until the situation is addressed and corrected." *Id.* at 10 (quoting Ex. 1001, col. 9, ll. 29–35); *see* Ex. 2004 ¶ 38. Patent Owner insists that the *only* disclosure of the "priming flow value" in either Figure 4A or 4B is in connection with the *initial* priming control provided by priming alarm step 421. PO Resp. 10–11. Further, Patent Owner argues that claim 12 is limited strictly to the disclosure of Figure 4A and to the associated disclosure of columns 8 and 9 of the Specification. *Id.* at 14–15; Tr. 43:17–23.

In addition, Patent Owner argues that the start of the priming alarm procedure at step 421 is not triggered by a loss of prime, but instead by the "PRESS 'START'" at step 408. PO Resp. 11 (citing Ex. 1001, col. 9, ll. 25–28, Fig. 4A). Patent Owner maintains that any construction that is not limited to this *initial* priming control after the "Press 'Start'" of step 408 reads the language of claim 12 out of context of the Specification of the '479 Patent. *Id.* Further, Patent Owner argues that the Specification of the '479 Patent does not disclose the scenario in which prime is lost after step 420, and priming alarm step 421 is

performed again. According to Patent Owner, the concept of triggering priming alarm 421 at any point after the system primed 420 step is unsupported by the Specification of the '479 Patent. *Id.* During the Oral Hearing, however, Patent Owner acknowledged that the priming alarm could be triggered when the shaft power approaches zero, consistent with the language of unchallenged claim 13 and the depiction of Figures 4A and 4B. Tr. 45:6–46:2.

Petitioner replies to Patent Owner's arguments noting that claim 12 recites the words "is primed" and "is not primed," rather than "has become primed" or "has become not primed." Pet. Reply 1. Petitioner contends that the language of claim 12 does not distinguish between the start-up of the pump, during which prime is acquired initially, and the operation of the pump, during which there may be a loss of prime. *Id.* Moreover, Petitioner contends that claim 12 does not include any limitation suggesting the order of the recited steps and that claim 12 does not recite that the priming flow value only may be considered *before* regular operation. *Id.*

In particular, Petitioner contends that, with regard to Figure 4A, the Specification of the '479 Patent discloses consideration of the priming flow rate at step 410 *before* normal operation of the pump's flow control at step 412, and that the Specification also discloses consideration of the priming flow rate at step 410 *after* the normal operation of the pump's flow control at step 412. *Id.* at 2 (citing Ex. 1001, col. 8, l. 65–col. 9, l. 7; col. 9, ll. 19–24). Moreover, referring to Figures 4A and 4B, Petitioner contends that these figures depict that the process flow may proceed uninterrupted from step 412 to step 410 in order to make the priming flow comparison. *Id.* (citing Ex. 1001, col. 3, ll. 26–27, Figs. 4A and 4B). Thus, Petitioner contends that, when the comparison occurs at step 412 *after* the pump already has been running, the comparison with a priming flow rate would indicate

an unprimed condition after normal operation of the pump, i.e., a loss of prime condition. *Id.*

Finally, Patent Owner argues that the Specification of the ’479 Patent indicates that consideration of the priming flow is “repeated.” PO Resp. 10 (citing Ex. 1001, col. 9, ll. 19–35). According to Patent Owner, this repeated consideration is consistent with the evaluation of initial priming status, rather than operational priming status. *Id.* at 10–11. Even though the Specification may describe this possibility (Ex. 1001, Fig. 4A), Petitioner contends correctly that claim 12 does not recite such repeated consideration of the “priming flow” (Pet. Reply 2). Thus, Petitioner contends that the plain language of claim 12 supports our construction of the terms “is primed” and “is not primed” and that our construction is not inconsistent with the Specification of the ’479 Patent. *Id.*

With respect to the meaning of “primed,” we conclude that claim 12 does not makes clear by its language that the word “primed” should be understood to mean “initially primed” or primed after the pressing of a “Start” button. As Patent Owner acknowledged at Oral Hearing, the claim language does not mention the term “initial” or “start” (Tr. 38:23–40:6) and, despite Patent Owner’s argument regarding the appropriate interpretation of “primed” in view of the Specification, we are not persuaded that the Specification limits “primed” in the manner argued by Patent Owner. Consequently, we conclude that the Specification does not express a clear intent to deviate from the plain meaning of the word “primed.” *See Thorner v. Sony Computer Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012) (“It is not enough for a patentee to simply disclose a single embodiment or use a word in the same manner in all embodiments, the patentee must clearly express an intent to redefine the term” (citations omitted; internal quotation marks omitted)).

We are persuaded by Petitioner that our construction of the terms "is primed" and "is not primed," as set forth in our Decision on Institution represents "the broadest reasonable meaning of the words in their ordinary usage, as those words would be understood by one of ordinary skill in the art, taking into account any definitions supplied by [patentee's] Specification" (*In re Morris*, 127 F.3d 1048, 1054 (Fed. Cir. 1997)), and we confirm that construction here (Dec. on Inst. 11 (citing Ex. 3001)). Despite Patent Owner's arguments, we are not persuaded that patentee has supplied here such a definition limiting "primed" to "become primed" or "initially primed" with sufficient clarity, deliberateness, and precision. *Paulsen*, 30 F.3d at 1480.

In addition, if Figures 4A and 4B of the '479 Patent depict embodiments covered by claims 12 and 13, respectively, the use of variants of the word "prime" in each claim is relevant to the interpretation of that word in the other claim. The Federal Circuit has acknowledged that other claims of the patent can be valuable sources of enlightenment as to the meaning of a term of a challenged claim. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). Because claim terms generally are used consistently throughout a patent, the usage of a term in one claim may illuminate the meaning of the same term in other claims. *See Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342 (Fed. Cir. 2001). Absent a clear showing in the Specification or in the claim language itself, that patentee intended that the word has different meanings in each claim, we construe the word consistently across the claims.

Finally, in construing the language of claim 12, we do not incorporate limitations from the Specification into that claim. Patent Owner argues that we should construe claim 12 to limit the definition of the terms "is primed" or "is not primed" to determining whether the pumping system is primed initially or at start

up and to determining repeatedly whether the pumping system is primed initially or at start up. As we noted above, in the absence of such a special definition or other considerations, "limitations are not to be read into the claims from the specification." *Van Geuns*, 988 F.2d at 1184. Moreover, "interpreting what is *meant* by a word *in* a claim is not to be confused with adding an extraneous limitation appearing in the specification, which is improper." *In re Cruciferous Sprout Litigation*, 301 F.3d 1343, 1348 (Fed. Cir. 2002) (internal quotation marks and citations omitted).

We are not persuaded that the single embodiment of the pumping system in Fig. 4 A of the '479 Patent controls the interpretation of claim 12. Although the Specification should be used to interpret the meaning of a claim, it should not be used to import unnecessary limitations into the claims. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005) (en banc). In particular, the Federal Circuit has "expressly rejected the contention that if a patent describes a single embodiment, the claims of the patent must be construed as being limited to that embodiment." *Id.* at 1323.

For the reasons set forth above, for this final decision, we construe the verb phrases "is primed" and "is not primed" to describe the primed status of the system at start-up, at restart, or when a loss of prime condition is determined, by comparison of the "current flow rate" to a "priming flow rate."

2. "Maximum Priming Time Allotment"

With respect to our initial construction of the term "maximum priming time allotment," Patent Owner contends that we present two constructions of this term which are inconsistent with each other. PO Resp. 7–8. In particular, we construed the "maximum priming time allotment" as the period between start-up, restart, or the determination of a loss of prime *and* the determination that the system "is

primed" or "is not primed." Dec. on Inst. 16. Further, we construed the "maximum priming time allotment" also to mean the maximum time allowed for the system to prime after start or restart or after a loss of prime condition is determined. *Id.* Specifically, Patent Owner contends that the "maximum priming time allotment" logically must have a start and an end, i.e., to quantify the time allotment. *See* Ex. 2004 ¶¶ 35, 37, 40. Patent Owner contends that "[t]he first construction establishes a *variable* period (i.e., the period ending with the 'determination that the system 'is primed' or 'is not primed'') whereas the second construction establishes a *fixed* period (i.e., the period ending at the expiration of the 'maximum time allowed')." PO Resp. 7–8 (emphasis added); *see* Ex. 2004 ¶¶ 35, 37, 40. Patent Owner maintains instead that the "maximum priming time allotment" must have a beginning time and an ending time and that the controller must determine whether the pumping system is primed at least once prior to the expiration of the "maximum priming time allotment." PO Resp. 16–17.

We agree with Patent Owner that, although the *absolute* duration of the "maximum priming time allotment" may vary, e.g., may be programmable (*id.*; *see* Pet. Reply 3), the "maximum priming time allotment" must have a beginning time and an ending time (PO Resp. 16–17). Thus, in a relative sense, we agree that the duration of the "maximum priming time allotment" is *fixed*. We disagree, however, that the beginning time for the "maximum priming time allotment" is when the pump motor is activated or when the "Start" button is pressed. PO Resp. 18–20. As Patent Owner acknowledges, claim 12 does not expressly recite the activation or starting of the recited motor or the pressing of a button to start the motor. Tr. 39:22–40:6; 42:13–25. Nevertheless, Patent Owner argues that our construction fails to reflect accurately the context of the Specification of the '479 Patent, in which the term must be construed. For instance, Patent Owner argues

that the Specification of the ’479 Patent provides no disclosure to support the scenario in which the “maximum priming time allotment” is measured, triggered, or determined by a loss of prime. PO Resp. 8 (citing Ex. 2004 ¶¶ 33–34, 36, 39–40). To the contrary, Patent Owner argues that the Specification only describes the maximum priming time allotment in the context of priming alarm step 421, which is triggered by “PRESS ‘START’” at step 408 of Figure 4A. *Id.* at 9 (citing Ex. 1001, col. 9, ll. 19–35). Once the start button is pressed at step 408, priming alarm step 421 implements an iterative comparison (steps 408, 410, and 412) of the flow to the priming flow value until either the flow exceeds the priming flow value or the maximum priming time allotment is exceeded. *Id.* We agree that the term covers this process, but we are not persuaded that it is limited to this process.

Although Figure 4A of the Specification describes an example in which the pumping system determines whether the pumping system is primed after start up, linked Figure 4B of the Specification describes an example in which the pumping system determines whether the pumping system remains primed during operation. PO Resp. 12–14; Pet. Reply 2. As noted above, Patent Owner argues that the right side of Figure 4A relates solely to claim 12 (Tr. 43:17–23) and that the left side of Figure 4A and linked Figure 4B relate solely to claim 13 (*id.* at 50:17–51:4). Nevertheless, Patent Owner fails to identify anything in the Specification (or in the prosecution history) of the ’479 Patent that states this distinction. In the context of the Specification, linked Figures 4A and 4B represent overlapping, rather than clearly distinct, concepts.

We do not find that the Specification provides an express definition of the term. In the only use of the term, the Specification states that:

> Within step 421, a determination concerning a priming alarm is made. Specifically, if priming control (i.e., the system is determined to be primed), is not reached prior to a *maximum priming time allotment*, a

> priming alarm is displayed, and the process 400 is interrupted and does not proceed any further until the situation is addressed and corrected.

Ex. 1001, col. 9, ll. 28–34 (emphasis added). Referring to Figures 4A and 4B, however, step 421 receives input regarding both initial and operational priming status. *See* Ex. 1001, Fig. 4A (steps 408 and 414). Thus, we determine that this description does not limit the term exclusively to either usage.

On this record, we are unwilling to construe the term "maximum priming time allotment" narrowly, as proposed by Patent Owner. Instead, we are persuaded that, given our construction of the terms "is primed" and "is not primed," the beginning of the "maximum priming time allotment," i.e., "*the moment when the timer starts ticking* can be at or in relation to a start *or* a restart *or* a loss of prime event." Pet. Reply 3. Therefore, for this final decision, we construe the term "maximum priming time allotment" to mean the "maximum time allowed for the system to prime after start or restart or after a loss of prime condition is determined."

For this final decision, we adopt and apply the foregoing constructions, as well as our constructions of other claim terms, as set forth in our Decision on Institution. Dec. on Inst. 9–16. All remaining claim terms and phrases recited in the challenged claims need not be construed expressly here.

B. Asserted Grounds of Unpatentability

1. Introduction

Patent Owner alleges specific disputes involving material facts in this case. PO Resp. 3–4. Petitioner disagrees with Patent Owner on each of these disputes. Pet. Reply vii. Patent Owner contends that we may conclude that claim 12 is not unpatentable if we agree with Patent Owner's claim construction or if we determine that the combination of Rasmuson and Møller '042 does not render the

claim unpatentable. Tr. 36:13–37:12. In view of the foregoing claim construction, Patent Owner's arguments to distinguish claim 12 over Rasmuson and Møller '042 based on Patent Owner's proposed claim constructions now are moot.[4] *See* PO Resp. 21–28. Thus, it only remains to be resolved whether the combination of the teachings of Rasmuson and Møller '042 render claim 12 obvious.

2. Rasmuson and Møller '042

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter[,] as a whole[,] would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We instituted this *inter partes* review on Petitioner's asserted grounds of unpatentability that claim 12 of the '479 Patent is rendered obvious over Rasmuson and Møller '042. To support these asserted grounds, Petitioner provides detailed explanations, and the declaration of Dr. Emadi,[5] to show how the combined

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[4] Patent Owner also argues that Rasmuson teaches away from the *initial* priming control as recited in claim 12 of the '479 Patent. PO Resp. 37–40; *see also* Paper 35 ¶¶ 31–33 (Rasmuson not related to priming at all); *but see* Paper 40, 14–15. However, because we conclude that claim 12 is not limited to *initial* priming control, but also encompasses loss of prime control, we are not persuaded by Patent Owner's teaching away arguments.

[5] Dr. Emadi provided a declaration with the Petition and was cross-examined on this declaration. However, Dr. Emadi suffered a heart attack in April 2014, and

references teach or suggest all of the claim limitations of claim 12. *See* Pet. 30–33.

Petitioner argues that Rasmuson discloses each and every element of the invention recited in claim 12, except that Rasmuson teaches determining "current flow rate" by use of a flow sensor, rather than determining "current flow rate based on an input power to the motor." Pet. 22. In particular, Petitioner maps Rasmuson to the elements of claim 12 in Claim Chart 4, but notes that Rasmuson

> discloses that the controller 46 is in communication with a flow transducer 30. [*See, e.g.,* Ex. 1021, col. 5, ll. 11–15.] The flow transducer 30 measures the "flow rate of the fluid being discharged by the pump" and transmits an electrical signal representative of this flow rate to the controller 46. [*See id.* at ll. 41–44 and 52–54.]

Pet. 23–25.

Petitioner argues that Møller '042 discloses a pumping system that regulates and assesses flow rate. *Id.* at 30. Like Rasmuson, Møller '042 discloses a pumping system including a pump, a motor coupled to the pump, and a controller in communication with the motor. *Id.* at 31 (citing Ex. 1003, Abstract; Fig. 5; col. 1, ll. 8–14). In particular, Møller '042 describes that its controller relates the measured input power to an actual value for a delivery variable in order to regulate the flow rate of the pump. *Id.* (citing Ex. 1003, col. 3, ll. 33–42). Specifically, Møller '042 states that, "the input power P, specifically the effective power and not the apparent or reactive power*, of the motor is measured as [a] parameter for the actual value of the delivery variable*." Ex. 1003, col. 3, ll. 39–42 (emphasis added). In addition, the Specification of the '479 Patent makes clear that

> The disclosures of [U.S. Patent No. 6,354,805 B2 to Møller and Møller '042] are incorporated herein by reference. In short summary, direct sensing of the pressure and/or flow rate of the water is not

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Dr. Toliyat replaced him for the purpose of offering a rebuttal declaration and sitting for cross-examination thereon. Paper 40, 10 n.2.

> performed, but instead one or more sensed or determined parameters associated with pump operation are utilized as an indication of pump performance. *One example of such a pump parameter is input power. Pressure and/or flow rate can be calculated/determined from such pump parameter(s).*

Ex. 1001, col. 6, ll. 17–32 (emphasis added). Thus, as the Specification of the ’479 Patent acknowledges, Møller ’042 discloses the measurement of the input power to the pump motor and the determination of flow rate based on such measurement. Pet. 31–32.

Petitioner further argues that a person of ordinary skill in the relevant art would have reason to modify the teachings of Rasmuson in view of the teachings of Møller ’042 to achieve the invention recited in claim 12. *Id.* at 33. In particular, Petitioner argues that it would have been obvious to a person of ordinary skill in the relevant art to apply the known power measuring techniques of Møller ’042 to improve Rasmuson’s pumping system and, specifically, to improve Rasmuson’s pumping system by providing a power measuring technique that eliminates “the need for a probe to be placed in the water, which may become contaminated, or require piping to be cut.” *Id.*; *see also KSR*, 550 U.S. at 417 (“[W]hen a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.” (citations omitted)).

a. Alleged Deficiencies in Rasmuson

Patent Owner argues that, even under the claim construction set forth in the Decision on Institution (and substantially confirmed above), the combination of the teachings of Rasmuson and Møller ’042 do not teach or suggest a “controller indicating a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment.” PO Resp. 28–30. Petitioner relies on

Rasmuson to teach or suggest this limitation. Pet. 23. In particular, Patent Owner argues that Rasmuson teaches the use of a "set flow" potentiometer in combination with a "cut-off delay" potentiometer to set a desired flow and a desired cut-off delay, respectively. PO Resp. 28 (citing Ex. 1021, col. 6, ll. 56–65; col. 7, ll. 5–15). If the measured flow drops below the "set flow" rate for a *time* equal to or greater than the set "cut-off delay," Rasmuson's motor cut-off switch is activated. *Id.* (citing Ex. 1021, col. 7, ll. 15–21).

Patent Owner argues that the low flow, i.e., the failure to reach the set flow rate within the permitted time, is due to the presence of gas in the oil well environment in which Rasmuson's pump is used. *See id.* at 28–29. Consequently, Patent Owner argues that Rasmuson's low flow is not due to a loss of prime, but instead is due to flow abnormalities caused by "inherent fluctuations to flow, such as the presence of gas." *Id.* at 29. Thus, Rasmuson's pump may continue to operate despite the presence of some gas. *Id.* As Patent Owner notes,

> when setting the desired cut-off delay, Rasmuson expressly discloses that "*[t]he desired cut-off delay is dependent on the amount of gas in the flow* through the downhole flow meter. [Ex. 1021, col. 7, ll. 23–25.] For example, in the case of a well having low gas content, Rasmuson describes "the setting may be as low as one second." [*id.* at col. 7, ll. 27–29.]

PO Resp. 29 (emphasis added).

As explained in our Decision on Institution, loss of prime may be due to the presence of too little fluid or too much gas in the pump. Dec. on Inst. 12 (citing Pet. 8); *see* Ex. 1018 ¶¶ 29–30. Although Patent Owner's declarants, Dr. Collins and Dr. Wooley, testify that Rasmuson does not teach determining whether the pump is or is not primed *at start up* (*see* Pet. Reply 5 (citing Ex. 2005 ¶ 27; Ex. 2004 ¶ 48; Ex. 1042 ¶ 28; Ex. 1043, 155:13–19)), Dr. Wooley acknowledges

that Rasmuson teaches priming control during operation. Pet. Reply 4–5 (citing Ex. 1042, 153:6–8). Therefore, we are persuaded the activation of the motor cut-off switch due to the presence of too much gas in the flow teaches or suggests a motor shut down due to the loss of prime.

b. Sufficiency of Reasons to Combine Rasmuson and Møller '042

Patent Owner next argues various reasons why a person of ordinary skill in the relevant art would not have combined the teachings of Rasmuson and Møller '042 to achieve the pumping system recited in claim 12. PO Resp. 30–59. After consideration of the parties' remarks and supporting evidence, we are not persuaded by Patent Owner's arguments and conclude that a person of ordinary skill in the relevant art would have had reason to combine the references in the manner proposed by Petitioner.

Petitioner contends that the measurement of input power, as taught by Møller '042, is a proxy for Rasmuson's flow transducer's measurement of actual flow rate and would represent an improvement on Rasmuson's methods and systems for measuring flow.[6] Pet. 33; *see* Ex. 1018 ¶ 61 ("The controller of the Møller '042 Patent correlates the input power to a delivery variable of the pump (flow rate or pressure)." (citing Ex. 1003, col. 3, ll. 33–42)); Ex. 1037 ¶ 38 ("In many cases, using power-sensing techniques is a better option than using a flow transducer . . .").[7] In particular, Petitioner contends that "providing a power

[6] Patent Owner argues that Møller '042 teaches away from Rasmuson because Rasmuson teaches *direct* flow measurement and Møller '042 teaches *indirect* flow measurement. PO Resp. 58–59. We do not find a clear teaching away from the substitution of one flow measurement means for its *functional* equivalent. For the reasons set forth above, we are not persuaded by those arguments.

[7] Dr. Schaaf testified that the use of power meters was less invasive than the installation of flow sensors at the pump and that, after utilizing a controller that measured electrical power to detect loss of prime, pump life was increased from

measuring technique [eliminates] the need for a probe to be placed in the water, which may become contaminated, or require piping to be cut." Pet. 33; *see* Ex. 1037 ¶¶ 29–40; *see also KSR*, 550 U.S. at 417 (arrangement of known elements according to their understood functions).

i. Lack of Improvement

Patent Owner argues that, contrary to Petitioner's contentions, combining the teachings of Møller '042 with those of Rasmuson would not improve the pumping methods and systems taught by Rasmuson. PO Resp. 30–32. This argument assumes that a person of ordinary skill in the art would not modify the teachings of Rasmuson to employ a less effective flow sensor. In particular, Patent Owner argues that Rasmuson's pumping methods and systems are intended for use in well pumps that "encounter <u>variable</u> friction loads that *may or may not* have an impact on flow rate." *Id.* at 30 (emphasis added). Nevertheless, Patent Owner's arguments are directed to pumps experiencing variable friction loads that impact flow rate. In particular, Patent Owner asserts alleged deficiencies of the use of input power as a proxy for actual flow rate. *Id.* (citing Ex. 2004 ¶¶ 62–65; Ex. 2005 ¶¶ 32–34).

In particular, Patent Owner argues that

> a worn pump *driven by a long, thin rod* (*e.g.*, "a rotary sucker rod string 23 which . . . is driven by a rotary electric motor 24 which is mounted to the wellhead 26") interjects a variable friction load into the overall system, which manifests as a fluctuating electrical load on the motor. *See*, *e.g.*, [Ex. 1021, col. 4, l. 67–col. 5, l. 3.]

PO Resp. 30. Patent Owner contends that input power to such pumps would vary almost constantly. *Id.* Patent Owner acknowledges that such varying input power

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about six months to about eighteen months. Ex. 1038 ¶ 19; *but see* Paper 35 ¶¶ 16–18 (alleged reasons not to combine).

might have some relation to the flow rate, but Patent Owner argues that it cannot always be reliably correlated to current flow. *Id.* at 30–31.

Patent Owner's arguments are based, in large part, on the testimony of Dr. Collins and Dr. Wooley. *Id.* (citing Ex. 2004 ¶¶ 62–65; Ex. 2005 ¶¶ 32–34). Dr. Collins testified that Rasmuson's methods and systems are for use in a system in which "[t]he motor is located at the surface while the pump is located at the bottom of the well." Ex. 2004 ¶ 50. Rasmuson, however, is not limited to such pumps. During Dr. Collins's deposition, Petitioner noted that Rasmuson also describes the use of electrically energized submersible pumps in which the motor and the pump are located together. *See* Pet. Reply 10 (citing Ex. 1021, col. 1, ll. 33–43). Dr. Collins acknowledged that he had not applied Rasmuson's teachings regarding electrically energized submersible pumps in at least paragraphs 50 and 65 of his declaration. Ex. 1043, 142:16–143:7. Similarly, Dr. Wooley also narrowly interprets the relationship between Rasmuson's pump and pump motor. Dr. Wooley testifies that "[t]he pump system disclosed in Rasmuson includes a rod pump with a motor at the top of the well and the pump at bottom, with potentially thousands of feet between them." Ex. 2005 ¶ 42; *see also id.* ¶¶ 35, 41 (discussing disadvantages of pumps driven by long thin rods). For the reasons noted above, Rasmuson simply is not limited to such pumps. Therefore, we discount the testimony of Dr. Collins and Dr. Wooley regarding the relationship between Rasmuson's motor and pump.

In addition, in paragraph 65 of his declaration, Dr. Collins testified that "[t]he flow sensor in Rasmuson is located at the surface, separated by hundreds or thousands of feet from the pump itself." Ex. 2004 ¶ 65. We note, however, that Rasmuson describes that the flow sensor need not be separated from the pump, and, if separate, the separation and the transmission of electrical signals to a

controller are not significant factors. Ex. 1021, col. 1, ll. 18–20 ("a flow transducer that continuously measures pump discharge flow *at a location immediately adjacent* the pump and transmits electrical signals representing pump flow"). Again, this inconsistency causes us to discount the testimony of Dr. Collins regarding the required relationship between the flow transducer and the pump.

Finally, Patent Owner argues that the inherent variability and inapplicability of input power measurements between pumps in an oilfield setting make input power an unsuitable proxy for flow transducers. PO Resp. 31–32; *but see* Paper 33, 2 (citing Ex. 1045, 79:1–24 (discussing empirical relationships between input power and flow rate between wells)); Paper 38 ¶ 8 (citing Ex. 2010, 79:25–80:1). In particular, Patent Owner relies on Dr. Wooley's testimony that "[a] lookup table as [Dr.] Emadi describes would only be good for that exact set of conditions, one particular well at one point in time. However, this approach would not work given the ever changing variables in an oil well application as discussed throughout my declaration." Ex. 2005 ¶ 43; *see* PO Resp. 31. Dr. Wooley concluded that "using lookup tables in the manner described by [Dr.] Emadi would be impractical in oil pumping systems including the applications disclosed in Rasmuson." Ex. 2005 ¶ 43.

Petitioner's declarant, Dr. Toliyat, testified that the use of empirical relationships to correlate input power to flow rate for the purpose of determining loss of prime are not undermined by the use of these relationships in oilfield applications. Ex. 1037 ¶¶ 27–29; Paper 33, 3–4 (citing Ex. 1044, 64:24–69:19); *but see* Paper 35 ¶¶ 22–26 (loss of prime conditions); Paper 38 ¶ 10 (citing Ex. 2011, 62:25–63:10). Moreover, Dr. Toliyat bases his opinion, in part, on the descriptions of the use of such empirical relationships in unapplied, prior art

references: Ellis-Anwyl (Ex. 1039), Garmong (Ex. 1040), and Markuson (Ex. 1041). *See* Ex. 1037 ¶¶ 41–62. Further, Dr. Schaaf testified that, based on his years of experience in the oil production industry, power input to electrical submersible pumps was used as a proxy for flow transducers in order to calculate flow rate so as to detect loss of prime conditions. Ex. 1038 ¶¶ 17–19, 27; Paper 33, 2 (citing Ex. 1045, 59:9–61:4), 3 (citing Ex. 1045, 106:3–110:6); *but see* Paper 35 ¶¶ 7–15 (effects on empirical correlations), 19–21 (loss of prime conditions); Paper 38 ¶¶ 1–6 (regarding whether input power to the motor is a viable proxy for flow rate). As we noted above, Dr. Wooley bases his opinion, in part, on a misunderstanding of the spatial relationship between Rasmuson's pumps and motors. Ex. 2005 ¶ 42. For the foregoing reasons, we are persuaded by Petitioner that a person of ordinary skill in the art would have found the measurement of power input to determine flow rate to be a proxy for and an improvement over the use of a flow transducer.[8]

ii. Principle of Operation and Intended Purpose

Patent Owner also argues that the modification of the Rasmuson pump in view of the teachings of Møller '042 (1) would impermissibly change the principle of Rasmuson's operation or (2) would render Rasmuson unsatisfactory for its intended purpose. PO Resp. 22–37. After reviewing the parties' remarks and supporting evidence, we are not persuaded that the proposed combination of the teachings of Rasmuson in view of the teachings of Møller '042 is impermissible for either reason.

Patent Owner correctly states that "Rasmuson's principle of operation relies on sensing 'pump discharge flow and to deenergize the pump . . . in the event

[8] For these reasons, we are not persuaded by Patent Owner's arguments with respect to Examination Guidelines A–D and F of MPEP § 2143. PO Resp. 45–51.

pump discharge flow rate should fall below a predetermined set point for any number of reasons.'" *Id.* at 33 (quoting Ex. 1021, col. 2, ll. 30–34). Specifically, however, Patent Owner argues that the operation of Rasmuson's methods and systems "explicitly relies on an actual, *physical* measurement of flow" by flow transducers. PO Resp. 32 (emphasis added). We do not agree that Rasmuson's principle of operation is limited by the device used to measure the discharge flow rate.

Patent Owner argues that using the measurement of input power as a proxy for a flow transducer would change Rasmuson's principle of operation for several reasons. First, Patent Owner argues that calculations of flow rate based on input power are not as accurate as the flow rate determined by a flow transducer in view of the unique attributes of the oilfield environment in which Rasmuson is used. *Id.* at 33–35 (citing Ex. 2005 ¶¶ 33–35, 37–42). Nevertheless, consideration of these unique characteristics of particular pieces of equipment and particular environmental conditions unnecessarily narrows Rasmuson's principles of operation. *See* Ex. 1021, col. 2, ll. 30–34. Moreover, to the extent that Patent Owner relies on Dr. Wooley's understanding of Rasmuson, as discussed above, Dr. Wooley's understanding of Rasmuson is too narrow. *See supra* Sec. II.B.2.b.i. Further, as noted above, Petitioner's declarants, Dr. Emadi, Dr. Toliyat, and Dr. Schaaf, have testified persuasively that measurement of power input is and has been an accurate proxy for flow transducers to detect loss of prime. *See, e.g.*, Ex. 1018 ¶¶ 24–25; Ex. 1037 ¶¶ 27–29; Ex. 1038 ¶¶ 17–19. Second, Patent Owner argues that Rasmuson's methods and systems provide for the flow transducer to be mounted to the flow line near the wellhead or at the surface of the well, "which is hundreds or thousands of feet above the pump." PO Resp. 35–36 (citing Ex. 1021, col. 5, ll. 11–12; Ex. 2005 ¶ 65; Ex. 2004 ¶¶ 41–42). However, as discussed

above, Rasmuson also describes an embodiment in which the discharge flow rate is measured adjacent to the pump. Ex. 1021, col. 1, ll. 18–20. Third, Patent Owner again asserts that, because Rasmuson requires a long rod connecting the pump to the motor, the measurement of motor input power is not a suitable proxy for a flow transducer. PO Resp. 36–37 (citing Ex. 2005 ¶ 65; Ex. 2004 ¶¶ 41–42). As discussed above, however, Rasmuson also describes an embodiment that employs an electrical submersible pump combining the pump and the motor. Ex. 1021, col. 1, ll. 33–43. Consequently, we are not persuaded that the modification of Rasmuson in view of Møller ’042 impermissibly changes a principle of Rasmuson’s operation.

Patent Owner also argues that the proposed modification of Rasmuson would render Rasmuson unsatisfactory for its intended purpose. In particular, Patent Owner argues that “Rasmuson is concerned with accommodating for ‘the presence of gas within the crude oil,’ and protecting a ‘pump [that has] become worn’ or is experiencing ‘excessive load, due to fouling by solid components of the well fluid or due to the presence of deposits in the pump from the well fluid.’” PO Resp. 33 (quoting Ex. 1021, col. 1, ll. 55–58; col. 2, ll. 1–5, 10–14). Patent Owner, however, proposes too narrow a description of Rasmuson’s intended purpose. Patent Owner describes specific problems that embodiments of Rasmuson’s methods and systems are designed to handle, but Rasmuson’s intended purpose is more broadly to control pumps experiencing low flow rates of operation. *See* Ex. 1021, col. 1, ll. 6–31. We are persuaded that modifying the teachings of Rasmuson to use the measurement of motor power input to calculate flow rate instead of or in addition to the use of a flow transducer for the same purpose would not render Rasmuson unsatisfactory for its intended purpose.

iii. Allegation that Rasmuson Is Not Analogous Art to Claim 12

Patent Owner argues that Rasmuson is not analogous art to claim 12 of the ’479 Patent. In particular, Patent Owner argues that Rasmuson is neither from the same field of endeavor as the claimed invention nor is it reasonably pertinent to the problem faced by the patentee. PO Resp. 40–43 (citing *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004)). For the following reasons, we conclude that Rasmuson is analogous art to the pumping system recited in the challenged claim.

Patent Owner argues that “Rasmuson states that it ‘relates generally to pumps that are located downhole within wells for pumping well fluid, typically petroleum products and water, which enter the wells from oil bearing subsurface formations.’” PO Resp. 41 (quoting Ex. 1021, col. 1, ll. 6–9); *see* PO Resp. 40–42.[9] In particular, Patent Owner argues that Rasmuson relates to downhole pumps joined by a long rod to motors located at the surface. As discussed above, however, Rasmuson describes multiple pump types, including pumps driven by a long rod or shaft separating the pump from the pump motor (Ex. 1021, col. 4, l. 67–col. 5, l. 3) and electrical submersible pumps (*id. at* col. 1, ll. 6–9, 33–43). Further, claim 12 broadly recites “[a] pumping system for at least one aquatic application, the pumping system comprising: *a pump* . . .” (emphasis added). Suitable pump types are described broadly in the Specification of the ’479 Patent. *See, e.g.*, Ex. 1001, col. 4, ll. 27–38.

Moreover, Patent Owner argues that Rasmuson relates to oil rather than aquatic applications and that claim 12 is limited to aquatic applications. Despite Patent Owner’s arguments to the contrary (*see* Tr. 68:15–69:12), we are not

[9] Patent Owner argues that, as a result of statements during prosecution, Rasmuson relates *solely* to downhole pumps. PO Resp. 40 (citing Ex. 2006, 9). However, the cited statements relate to the distinguishing Rasmuson’s claims over applied art.

persuaded that the reference to "at least one aquatic application" in the preamble of claim 12 is a limitation. "In general, a preamble limits the invention if it recites essential structure or steps, or if it is 'necessary to give life, meaning, and vitality' to the claim." *Catalina Marketing Int'l., Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002) (quoting *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999)). "Conversely, a preamble is not limiting 'where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention.'" *Id.* (quoting *Rowe v. Dror*, 112 F.3d 473, 478 (Fed. Cir. 1997)). Here, we determine that the body of the claim describes a structurally complete invention and that the preamble neither recites structure nor is necessary to give life meaning or vitality to claim 12. Therefore, we are not persuaded by Patent Owner's arguments that Rasmuson is not analogous art based on the type of pumps described in Rasmuson or the aquatic applications for which the recited pumping systems are suitable.

Nevertheless, even if the reference to aquatic applications in the preamble of claim 12 were found somehow to limit the claim, we are not persuaded that this limitation would render Rasmuson non-analogous art. Patent Owner argues that the Specification of the '479 Patent describes the pumping system "in the context of variable speed centrifugal pump for use *in pools, spas, and other aquatic pump applications*." PO Resp. 42 (citing Ex. 1001, col. 4, ll. 4–13; col. 8, l. 13–col. 10, l. 56) (emphasis added). Patent Owner argues that "[t]he field of oil and gas well production and the field of pool, spa, and aquatic systems are vastly different, with little, if any, overlap from the perspective of one of ordinary skill in the art of either field." PO Resp. 42 (citing Ex. 2004 ¶¶ 42–43, 45–51, 53–54; Ex. 2005 ¶¶ 11–23).

Petitioner contends, and we agree, that Patent Owner's definition of "aquatic

application" is too narrow and is not supported by the Specification of the '479 Patent. Pet. Reply 6–7. As Petitioner notes, the Specification of the '479 Patent provides an inclusive definition of "aquatic application," stating that "the phrase 'aquatic application' is used generally herein to refer to *any* *reservoir*, tank, container *or* *structure*, *natural or man-made*, having a fluid, capable of holding a fluid, to which a fluid is delivered, or *from which a fluid is withdrawn*." Pet. Reply 7 (quoting Ex. 1001, col. 3, l. 54–58); *but see* Paper 35 ¶ 27 (Dr. Toliyat's understanding of "reservoir" in oilfield applications). Further, the Specification explains that "liquids other than water are also within the scope of the present invention" and "applications that include liquids other than water are also within the scope of the present invention." *Id.* Rasmuson describes that water, as well as oil, may be operated on by Rasmuson's methods and systems. Pet. Reply 7 (citing Ex. 1021, col. 1, ll. 5–10; col. 4, ll. 51–57). Moreover, as Patent Owner's declarant, Dr. Wooley, explains, "[a]t times, salt water from the reservoir can come into the wellbore and can even dwarf the amount of oil being pumped." Ex. 2005 ¶ 17; *see* Ex. 1042. Therefore, we determine that Rasmuson's methods and systems are for an aquatic application as that term is defined in the '479 Patent.

Although we need not reach the second prong of the test for analogous art, we note that Patent Owner argues that Rasmuson is directed to a problem that is not reasonably pertinent to claim 12 of the '479 Patent because of Patent Owner's proposed construction limiting claim 12 to the detection of priming status at start up. PO Resp. 42–43. Given our claim construction discussed above, we are not persuaded by these arguments. *See* Pet. Reply 8 (Rasmuson relates to "priming control"). Therefore, we conclude that Rasmuson is analogous art.

iv. Combination Based on Improper Hindsight

Patent Owner argues that Petitioner has relied on hindsight reasoning to piece together portions of Rasmuson and Møller ’042 to achieve the pumping system recited in claim 12. PO Resp. 55–57. In particular, Patent Owner argues that claim 12 was intended to solve “the problem of priming control at start up,” and that Petitioner’s reason for combining Rasmuson and Møller ’042 solves a different problem. *Id.* at 56. Moreover, Patent Owner argues that neither Rasmuson nor Møller ’042 is directed to the problem allegedly solved by claim 12. *Id.* at 56–57.

Initially, we note that

> Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill [in the art] at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.

In re McLaughlin, 443 F.2d 1392, 1395 (CCPA 1971). Further, in view of our claim construction, we do not agree that the problem solved by claim 12 may be narrowly limited to priming control at start up. Petitioner argues that Møller ’042 teaches a known alternative to Rasmuson’s flow transducers for determining flow rate. Pet. 30–33; Pet. Reply 5. Moreover, Petitioner’s declarants, Dr. Emadi, Dr. Toliyat, and Dr. Schaaf, testified that a person of ordinary skill in the art, at the time of the invention of the pumping system recited in claim 12, would have reason, apart from the disclosure of the ’479 Patent, to substitute for or augment Rasmuson’s flow transducer by the methods and apparatus taught by Møller ’042.[10] *See, e.g.*, Ex. 1018 ¶ 62; Ex. 1037 ¶ 30; Ex. 1038 ¶¶ 14, 27. Therefore, we

[10] In view of this discussion, we are not persuaded by Patent Owner’s arguments

are not persuaded that Petitioner relied on impermissible hindsight in combining the teachings of Rasmuson and Møller ’042.

From our review of the record and in view of the foregoing discussion, we conclude that Petitioner demonstrates by a preponderance of the evidence that independent claim 12 of the ’479 Patent is rendered obvious by the combination of the teachings of Rasmuson and Møller ’042.

C. Motion to Exclude Evidence

Patent Owner filed a Motion to Exclude certain evidence (Paper 34 (“Mot. to Excl.”)). Petitioner filed an Opposition to Patent Owner’s Motion to Exclude (Paper 39 (“Opp. to Excl.”)), and Patent Owner filed a Reply to Petitioner’s Opposition (Paper 41 (“Excl. Reply”). In particular, Patent Owner moves to exclude Petitioner’s exhibits, as follows:

Petitioner’s Exhibits	Proposed Grounds for Exclusion
Danfoss, VLT® AQUA Drive, “The ultimate solution for Water, Wastewater, & Irrigation” (May 2007) (Ex. 1034; “the Danfoss Brochure”)	FRE 401–403
Danfoss, VLT® SALT Drive Systems, Increase oil & gas production, Minimize Energy Consumption (marked Copyright 2011) (Ex. 1035; “the Danfoss Senorless Artificial Lift”)	FRE 401–403
Declaration of Hamid Toliyat, Ph.D., P.E. (Ex. 1037; “the Toliyat Declaration”)	FRE 401–403, 702
Declaration of Robert Schaaf (Ex. 1038; “the Schaaf Declaration”)	FRE 401–403, 702
U.S. Patent No. 4,021,700, issued May 3, 1977 (Ex. 1039; “Ellis-Anwyl”)	FRE 401–403, 801–807
U.S. Patent No. 4,473,338 issued September 25, 1984 (Ex. 1040; “Garmong”)	FRE 401–403, 801–807
U.S. Patent No. 4,767,280 issued August 30,	FRE 401–403, 801–807

with respect to Examination Guidelines A and G of MPEP § 2143. PO Resp. 44–45, 53–55.

Petitioner's Exhibits	Proposed Grounds for Exclusion
1988 (Ex. 1041; "Markuson")	

Mot. to Excl. 2–5; *see also* Ex. 2014 ¶¶ 2–5 (objections served by Patent Owner). As the moving party, Patent Owner bears the burden of establishing that it is entitled to the relief requested, namely, the exclusion of the identified exhibits. For the reasons set forth below, Patent Owner's Motion to Exclude these exhibits is *denied* or *dismissed as moot*.

1. *The Danfoss Brochure (Ex. 1034) and the Danfoss Senorless Artificial Lift (Ex. 1035)*

Patent Owner argues that each of the Danfoss Brochure (Ex. 1034) and the Danfoss Senorless Artificial Lift (Ex. 1035) was created after the priority date of the '479 Patent. Mot. to Excl. 5. Petitioner does not contest that the effective dates of these exhibits are after the priority date of the '479 Patent. Opp. to Excl. 6, 12–13. Nevertheless, we do not rely on Exhibit 1034 or Exhibit 1035 in reaching our decision herein. Accordingly, with respect to these exhibits, we dismiss the Motion to Exclude as moot.

2. *The Toliyat Declaration (Ex. 1037), Ellis-Anwyl (Ex. 1039), Garmong (Ex. 1040), and Markuson (Ex. 1041)*

Patent Owner objects to the Toliyat Declaration "as lacking foundation, assuming facts not in evidence, containing testimony on matters as to which the witness lacks personal knowledge, containing hearsay, and conclusory." Mot. to Excl. 3 (citing Ex. 2013 ¶ 4). Patent Owner, however, fails to identify specifically, which portions of the Toliyat Declaration are the subject of each of these objections, yet Patent Owner seeks to exclude the entirety of Ex. 1037. Mot. to Excl. 3, 9–10. We will not go through the Toliyat Declaration to determine which portions of the exhibit Patent Owner believes to be excludable under each of these

objections. Because Patent Owner bears the burden of establishing its entitlement to the relief it requests, this is something that Patent Owner should have done in its Motion to Exclude.

Despite Patent Owner's failure to identify the portions of the Toliyat Declaration which allegedly are being improperly offered for the truth of the matter asserted, we understand that Patent Owner's hearsay objections are due to Dr. Toliyat's reliance on Ellis-Anwyl (Ex. 1039), Garmong (Ex. 1040), and Markuson (Ex. 1041) in reaching his conclusions as to what a person of ordinary skill in the art would have known regarding the use of input power to a motor to identify flow rate. *See* Mot. to Excl. 9–10 (citing Ex. 1037 ¶¶ 43, 55, 60). Petitioner responds that the Toliyat Declaration, especially as it relates to Ellis-Anwyl (Ex. 1039), Garmong (Ex. 1040), and Markuson (Ex. 1041), describes the knowledge of a person of ordinary skill in the relevant art as of the priority date of claim 12 of the '479 Patent. Opp. to Excl. 7 (citing *Randall Mfg v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013)). We determine that these references merely represent underlying facts upon which Dr. Toliyat relied in reaching his conclusions regarding the knowledge of one of ordinary skill as of the priority date of claim 12 of the '479 Patent. *See* Opp. to Excl. 8–9.

Patent Owner further objects to the Toliyat Declaration under FRE 702 "for failing to demonstrate that the declarant is qualified as an expert in the relevant subject matter, failing to be based upon sufficient facts or data, as the product of unreliable principles and methods, and for failing to reliably apply sound principles and methods to the facts of the case." Mot. to Excl. 3–4. Patent Owner, however, fails to identify the portions of the Toliyat Declaration that fail to be based upon sufficient facts or data, are the product of unreliable principles and methods, or fail to reliably apply sound principles and methods to the facts of the case. Initially,

we note that there is no requirement for a perfect match between the expert's experience and the field of the patent. *SEB S.A. v. Montgomery Ward & Co.*, 594 F.3d 1360, 1372–73 (Fed. Cir. 2010). Thus, as with the objections discussed above, Patent Owner fails to meet its burden with respect to these objections. Further, with regard to these objections under FRE 702, we note that under 37 C.F.R. § 42.65(a), "[e]xpert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight." Consequently, this objection properly goes to the weight to be given Dr. Toliyat's testimony, and not to its admissibility.

Finally, Patent Owner also objects to the Toliyat Declaration "as irrelevant under FRE 401 and 402, and as unfairly prejudicial, confusing, and misleading under FRE 403." Mot. to Excl. 4. In particular, Patent Owner argues that Dr. Toliyat's conclusions based on his analysis of Ellis-Anwyl (Ex. 1039), Garmong (Ex. 1040), and Markuson (Ex. 1041) are "legally irrelevant to the issue of obviousness." Mot. to Excl. 9–10. In order to be relevant evidence under FRE 401 and 402, the exhibit must have a tendency to make a fact of consequence more or less probable, and admission must not be otherwise prohibited. Petitioner contends, however, that the discussion of these references in the Toliyat Declaration

> confirms that one of ordinary skill in the art knew to use empirical relationships between the electrical characteristics of the pump and the flow produced by the pump in an **oil** well pump for loss of prime purposes. Contrary to the Patent Owners' arguments, it is well settled that prior art that does not itself form the basis of a rejection nevertheless remains reliable evidence of the level of skill in the art.

Opp. to Excl. 8–9 (citations omitted). Thus, Petitioner contends that, because Patent Owner challenged the applicability of the teachings of Møller '042 in an oil

well environment, Dr. Toliyat's discussion of these references is relevant rebuttal testimony regarding what a person of ordinary skill in the relevant art would know as of the priority date of claim 12 of the '479 Patent. *Id.; but see* Excl. Reply 1–2 (citing PO Resp. 30–40). We are persuaded by Petitioner that Dr. Toliyat's testimony is relevant to reasons to combine the teachings of Rasmuson and Møller '042. Finally, regarding Patent Owner's objections under FRE 403, Patent Owner again fails to identify specifically the portions of the Toliyat Declaration that it believes to be "unfairly prejudicial, confusing, and misleading" and why we would be unable to weigh this evidence without prejudice or confusion and without being misled.

For the reasons set forth above, we deny Patent Owner's Motion to Exclude with respect to the Toliyat Declaration (Ex. 1037) and Ellis-Anwyl (Ex. 1039), Garmong (Ex. 1040), and Markuson (Ex. 1041).

3. The Schaaf Declaration (Ex. 1038)

As with the Toliyat Declaration, Patent Owner objects to the Schaaf Declaration "as lacking foundation, assuming facts not in evidence, containing testimony on matters as to which the witness lacks personal knowledge, containing hearsay, and conclusory." Mot. to Excl. 4 (citing Ex. 2013 ¶ 5). In addition, Patent Owner also objects to the Schaaf Declaration "as irrelevant under FRE 401 and 402, and as unfairly prejudicial, confusing, and misleading under FRE 403." Mot. to Excl. 4. Patent Owner, however, fails to identify specifically, which portions of the Schaaf Declaration are the subject of each of these objections, yet Patent Owner seeks to exclude the entirety of Ex. 1038. Mot. to Excl. 4, 10–13. As with the Toliyat Declaration, we will not go through the Schaaf Declaration to determine which portions of the exhibit Patent Owner believes to be excludable under each of these objections. Because Patent Owner bears the burden of

establishing its entitlement to the relief it requests, this also is something that Patent Owner should have done in its Motion to Exclude.

Patent Owner further objects to the Schaaf Declaration under FRE 702 "for failing to demonstrate that the declarant is qualified as an expert in the relevant subject matter, failing to be based upon sufficient facts or data, as the product of unreliable principles and methods, and for failing to reliably apply sound principles and methods to the facts of the case." Mot. to Excl. 4. We again note that there is no requirement for a perfect match between the expert's experience and the field of the patent. *SEB S.A.*, 594 F.3d at 1372–73. Further, of these objections, Patent Owner only argues with specificity that Mr. Schaaf failed to disclose the underlying facts and data upon which his opinions are based and that, although Mr. Schaaf refers to tests and data, Mr. Schaaf failed to sufficiently explain those tests, as required by the Board's Rules. Mot. to Excl. 10–11; *see also* Paper 35 ¶ 1–3 (collected and existing oilfield data); Paper 38 ¶ 9 (describing oilfield data collected). Specifically, "Mr. Schaaf provides four examples from his work experience where he claims he observed monitoring of pump input power as a proxy for flow rate" (*id.* at 11 (citing Ex. 1038 ¶¶ 17, 22, 25)), but Mr. Schaaf does not provide evidence of these or other tests in support of his opinions (*id.* at 11–13). *See* Paper 35 ¶¶ 4–6.

In response, Petitioner contends that these "examples" and "tests" are drawn from Mr. Schaaf's 25 years of experience in the oil business and not on tests performed in preparation for his testimony. Opp. to Excl. 10–11, *see also* Paper 40, 1 ("Patent Owners err in raising 37 C.F.R. § 42.65 and associated principles. Petitioner does <u>not</u> rely on the Schaaf declaration for the purpose of supplying any element recited by Claim 12."). Dr. Schaaf specifically states that "[his] expert opinions are narrowly limited to [his] personal knowledge of and experience with

using input power as an indicator of flow rate in oil well applications." Ex. 1038 ¶ 4. Thus, Petitioner maintains that Mr. Schaaf's testimony is supported properly by his practical experience as evidenced by the recounted "examples" and "tests." Opp. to Excl. 11. With regard to these objections under FRE 702, we again note that under 37 C.F.R. § 42.65(a), "[e]xpert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight." Consequently, this objection properly goes to the weight to be given Dr. Schaaf's testimony, and not to its admissibility.

For the reasons set forth above, we deny Patent Owner's Motion to Exclude with respect to the Schaaf Declaration (Ex. 1038).

III. CONCLUSION

Based on the foregoing discussion, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claim 12 is unpatentable under 35 U.S.C. § 103(a) over Rasmuson and Møller '042.

IV. ORDER

In consideration of the foregoing, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claim 12 of the '479 Patent is unpatentable under 35 U.S.C. § 103(a) over Rasmuson and Møller '042;

FURTHER ORDERED that Patent Owner's Motion to Exclude Evidence is *dismissed* as moot with respect to Exhibits 1034 and 1035 and *denied* with respect to Exhibits 1037–1041; and

FURTHER ORDERED that, because this is a final decision, parties to the proceeding seeking judicial review of the decision must comply with the notice

and service requirements of 37 C.F.R. § 90.2.

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EXHIBIT 1001

Hayward Exhibit 1001
Inter Partes Review of
US Patent No. 8,019,479

US008019479B2

(12) **United States Patent**
Stiles et al.

(10) **Patent No.: US 8,019,479 B2**
(45) **Date of Patent: Sep. 13, 2011**

(54) **CONTROL ALGORITHM OF VARIABLE SPEED PUMPING SYSTEM**

(75) Inventors: **Robert W. Stiles**, Holly Springs, NC (US); **Lars Hoffmann Berthelsen**, Randers (DK); **Ronald B. Robol**, Sanford, NC (US); **Christopher R. Yahnker**, Raliegh, NC (US); **Everett Cox**, Sanford, NC (US); **Donald Steen**, Sanford, NC (US); **Kevin Murphy**, Quartz Hill, CA (US); **Walter J. Woodcock, Jr.**, Sanford, NC (US); **Daniel J. Hruby**, Sanford, NC (US); **Peter Westermann-Rasmussen**, Soenderborg (DK); **Gert Kjaer**, Soenderborg (DK); **Einar Kjartan Runarsson**, Soenderborg (DK); **Arne Fink Hansen**, Graasten (DK); **Alberto Morando**, Soenderborg (DK); **Florin Lungeanu**, Graasten (DK); **Nils-Ole Harvest**, Nordborg (DK)

(73) Assignee: **Pentair Water Pool and Spa, Inc.**, Sanford, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1541 days.

(21) Appl. No.: **11/286,888**

(22) Filed: **Nov. 23, 2005**

(65) **Prior Publication Data**

US 2007/0114162 A1 May 24, 2007

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/926,513, filed on Aug. 26, 2004, now Pat. No. 7,874,808.

(51) **Int. Cl.**
G05D 9/12 (2006.01)
F04B 49/00 (2006.01)

(52) **U.S. Cl.** **700/282**; 134/6; 210/739; 417/42; 417/43; 417/44.1; 417/53

(58) **Field of Classification Search** 700/282; 417/42, 43, 44.1, 53; 134/6; 210/739; 340/825.69
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,613,805 A 10/1971 Linstad
(Continued)

FOREIGN PATENT DOCUMENTS

DE 19645129 5/1998
(Continued)

OTHER PUBLICATIONS

"Better, Stronger, Faster;" Pool & Spa News, Sep. 3, 2004; pp. 52-54, 82-84, USA.

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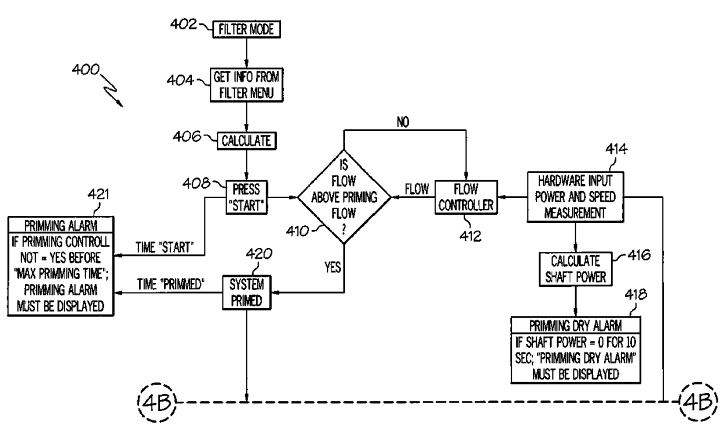
(74) *Attorney, Agent, or Firm* — Quartes & Brady LLP

(57) **ABSTRACT**

A pumping system includes a pump for moving water. In one aspect, this is in connection with performance of an operation. The system includes a variable speed motor operatively connected to drive the pump. A value indicative of flow rate of water is determined and the motor is controlled to adjust the flow rate indicative value toward a constant. A value indicative of flow pressure is determined and the motor is controlled to adjust the flow pressure indicative value toward a constant. A selection is made between flow rate control and flow pressure control. In another aspect, the pump is controlled to perform a first operation, and is operated to perform a second water operation. Control of operation of the pump to perform the first water operation is altered in response to operation of the pump to perform the second operation.

16 Claims, 10 Drawing Sheets



U.S. PATENT DOCUMENTS

3,778,804 A	12/1973	Adair	
3,787,882 A	1/1974	Fillmore	
4,353,220 A	10/1982	Curwen	
4,494,180 A	1/1985	Streater	
4,610,605 A	9/1986	Hartley	
4,678,409 A	7/1987	Kurokawa	
4,703,387 A	10/1987	Miller	
4,767,280 A	8/1988	Markuson	
4,795,314 A	1/1989	Prybella	
4,834,624 A	5/1989	Jensen	
4,912,936 A	4/1990	Denpou	
4,963,778 A	10/1990	Jensen et al.	
5,026,256 A	6/1991	Kuwabara	
5,099,181 A	3/1992	Canon	
5,117,233 A *	5/1992	Hamos et al.	340/825.69
5,123,080 A	6/1992	Gillett	
5,156,535 A	10/1992	Burdis	
5,158,436 A	10/1992	Jensen	
5,167,041 A	12/1992	Burkitt	
5,240,380 A	8/1993	Mabe	
5,342,176 A	8/1994	Redlich	
5,471,125 A	11/1995	Wu	
5,512,883 A	4/1996	Lane	
5,518,371 A	5/1996	Wellstein	
5,519,848 A	5/1996	Wloka	
5,520,517 A *	5/1996	Sipin	417/44.3
5,571,000 A	11/1996	Zimmermann	
5,580,221 A	12/1996	Triezenberg	
5,598,080 A	1/1997	Jensen	
5,614,812 A	3/1997	Wagoner	
5,626,464 A	5/1997	Schoenmyr	
5,628,896 A	5/1997	Klingenberger	
5,711,483 A	1/1998	Hays	
5,727,933 A	3/1998	Laskaris et al.	
5,791,882 A	8/1998	Stucker	
5,804,080 A *	9/1998	Klingenberger	210/739
5,819,848 A	10/1998	Rasmusson	
5,883,489 A	3/1999	Konrad	
5,909,372 A	6/1999	Thybo	
5,941,690 A	8/1999	Lin	
5,969,958 A	10/1999	Nielsen	
5,973,465 A	10/1999	Rayner	
6,037,742 A	3/2000	Rasmussen	
6,046,492 A	4/2000	Machida	
6,048,183 A	4/2000	Meza	
6,072,291 A	6/2000	Pedersen	
6,091,604 A	7/2000	Plougsgaard	
6,102,665 A	8/2000	Centers	
6,125,481 A	10/2000	Sicilano	
6,142,741 A	11/2000	Nishihata	
6,208,112 B1	3/2001	Jensen	
6,254,353 B1	7/2001	Polo	
6,264,431 B1	7/2001	Triezenberg	
6,299,414 B1	10/2001	Schoenmyr	
6,299,699 B1 *	10/2001	Porat et al.	134/6
6,326,752 B1	12/2001	Jensen	
6,351,359 B1	2/2002	Jaeger	
6,354,805 B1	3/2002	Moller	
6,373,728 B1	4/2002	Aarestrup	
6,380,707 B1	4/2002	Rosholm	
6,406,265 B1	6/2002	Hahn	
6,416,295 B1	7/2002	Nagai	
6,426,633 B1	7/2002	Thybo	
6,450,771 B1	9/2002	Centers	
6,464,464 B2	10/2002	Sabini	
6,468,042 B2	10/2002	Moller	
6,468,052 B2	10/2002	McKain et al.	
6,474,949 B1	11/2002	Arai	
6,481,973 B1	11/2002	Struthers	
6,483,278 B2	11/2002	Harvest	
6,548,976 B2	4/2003	Jensen	
6,604,909 B2 *	8/2003	Schoenmeyr	417/32
6,623,245 B2	9/2003	Meza	
6,676,831 B2	1/2004	Wolfe	
6,690,250 B2	2/2004	Moller	
6,715,996 B2	4/2004	Moeller	
6,717,318 B1	4/2004	Mathiassen	
6,747,367 B2	6/2004	Cline	
6,774,664 B2	8/2004	Godbersen	
6,925,823 B2	8/2005	Lifson	
7,005,818 B2	2/2006	Jensen	
7,050,278 B2	5/2006	Poulsen	
7,083,392 B2	8/2006	Meza	
7,221,121 B2	5/2007	Skaug	
2001/0041139 A1	11/2001	Sabini et al.	
2002/0050490 A1	5/2002	Pittman	
2002/0070875 A1	6/2002	Crumb	
2002/0136642 A1	9/2002	Moller	
2003/0017055 A1	1/2003	Fong	
2003/0099548 A1	5/2003	Meza	
2003/0196942 A1 *	10/2003	Jones	210/169
2004/0009075 A1	1/2004	Meza	
2004/0013531 A1	1/2004	Curry et al.	
2005/0123408 A1 *	6/2005	Koehl	417/53
2005/0190094 A1	9/2005	Andersen	
2005/0226731 A1	10/2005	Mehlhorn	
2006/0045750 A1	3/2006	Stiles	
2006/0090255 A1	5/2006	Cohen	
2006/0127227 A1	6/2006	Mehlhorn	
2007/0154319 A1	7/2007	Stiles	
2007/0154320 A1	7/2007	Stiles	
2007/0154321 A1	7/2007	Stiles	
2007/0154322 A1	7/2007	Stiles	
2007/0154323 A1	7/2007	Stiles	
2007/0163929 A1	7/2007	Stiles	
2007/0183902 A1	8/2007	Stiles	

FOREIGN PATENT DOCUMENTS

DE	EP 0 916 026 B1	2/2002
DE	10231773	2/2004
DE	19938490	4/2005
EP	0314249	5/1989
EP	0709575	5/1996
EP	0735273	10/1996
EP	0978657	2/2000
FR	2529965	6/1983
FR	2703409	10/1994
JP	5010270	1/1993
WO	WO 98/04835	2/1998
WO	WO 01/47099	6/2001
WO	WO 2004/006416	1/2004
WO	WO 2004/088694	10/2004
WO	WO 2006/069568	7/2006

* cited by examiner

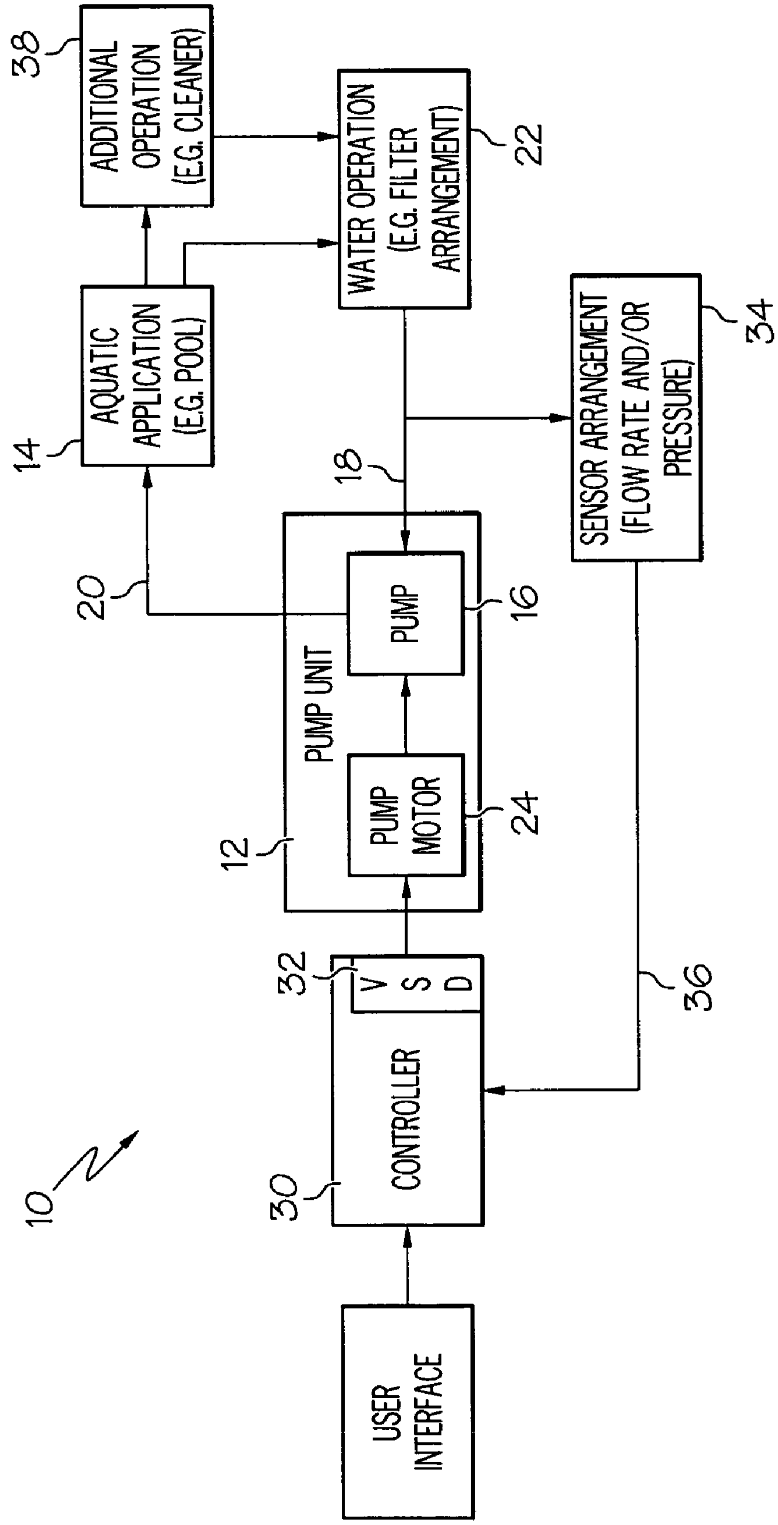

38
ADDITIONAL OPERATION (E.G. CLEANER)
WATER OPERATION (E.G. FILTER ARRANGEMENT)
22
14
AQUATIC APPLICATION (E.G. POOL)
SENSOR ARRANGEMENT (FLOW RATE AND/OR PRESSURE)
34
18
20
PUMP
16
PUMP UNIT
12
PUMP MOTOR
24
32
VSD
36
CONTROLLER
30
10
USER INTERFACE

FIG. 1

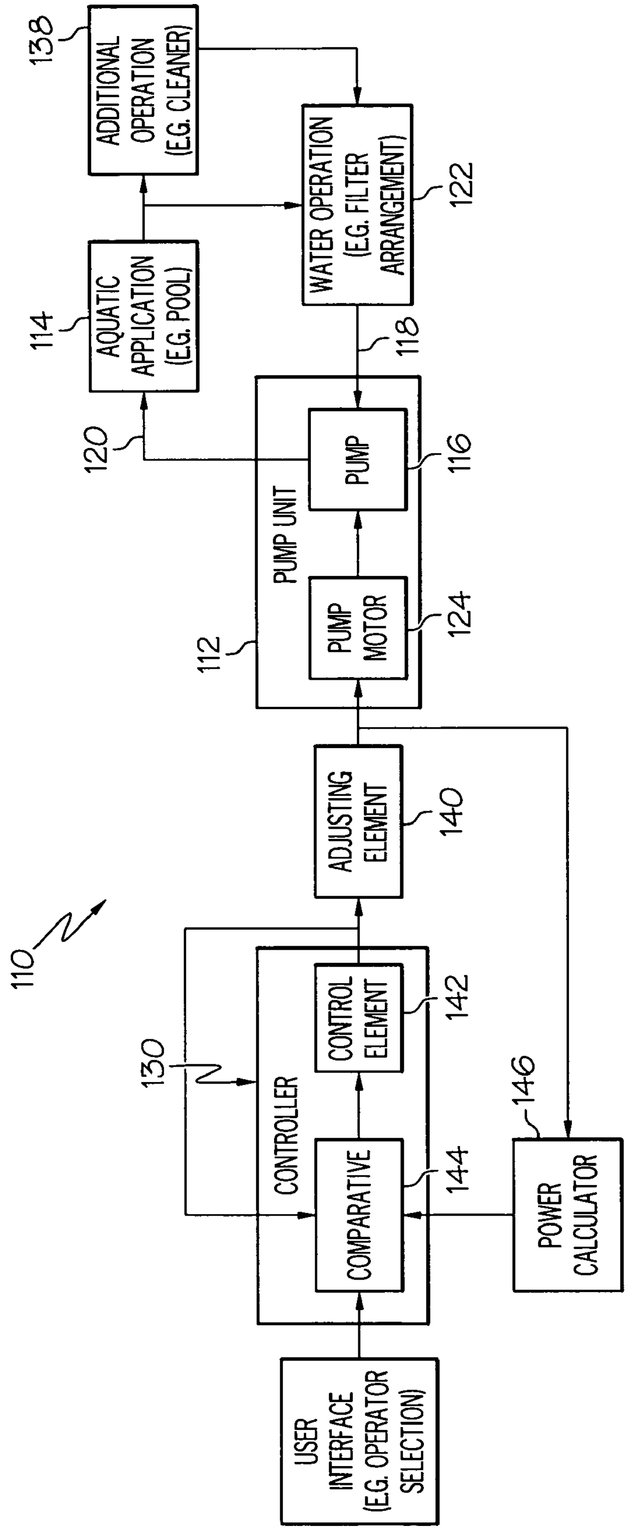

110
USER INTERFACE (E.G. OPERATOR SELECTION)
CONTROLLER
130
COMPARATIVE
144
CONTROL ELEMENT
142
POWER CALCULATOR
146
ADJUSTING ELEMENT
140
PUMP UNIT
112
PUMP MOTOR
124
PUMP
116
120
118
AQUATIC APPLICATION (E.G. POOL)
114
WATER OPERATION (E.G. FILTER ARRANGEMENT)
122
ADDITIONAL OPERATION (E.G. CLEANER)
138

FIG. 2

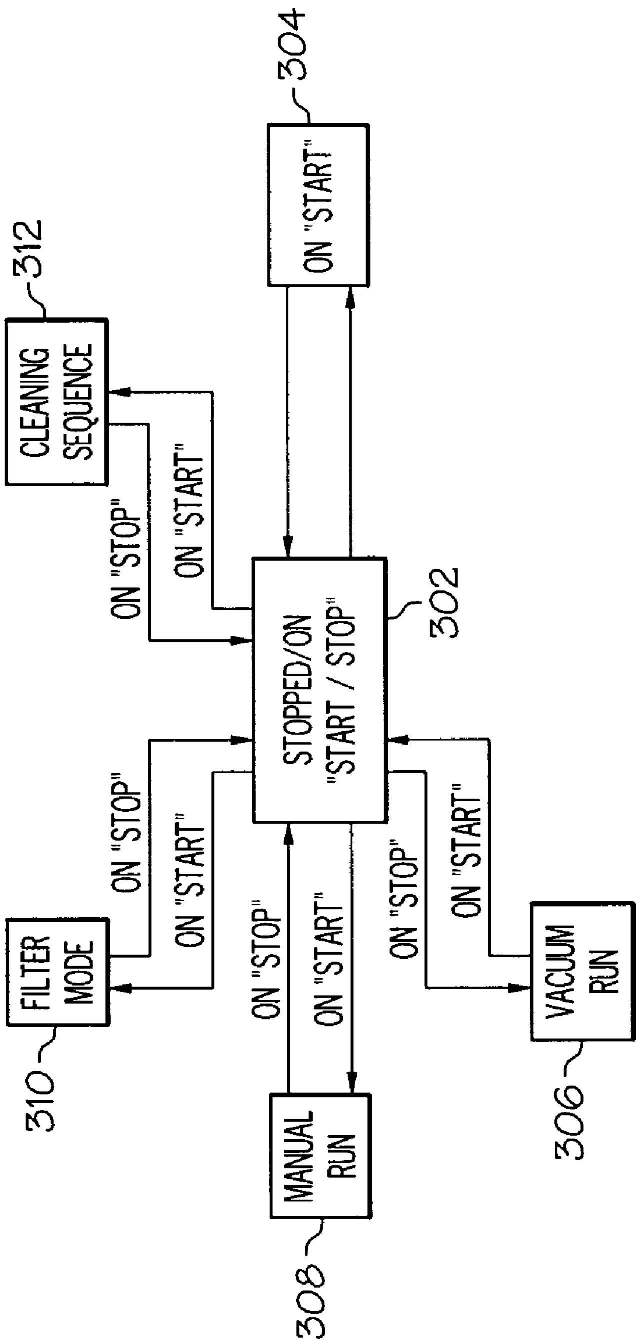

304
ON "START"
312
CLEANING SEQUENCE
ON "STOP"
ON "START"
STOPPED/ON "START / STOP"
302
ON "STOP"
ON "START"
FILTER MODE
310
ON "STOP"
ON "START"
MANUAL RUN
308
ON "STOP"
ON "START"
VACUUM RUN
306

FIG. 3

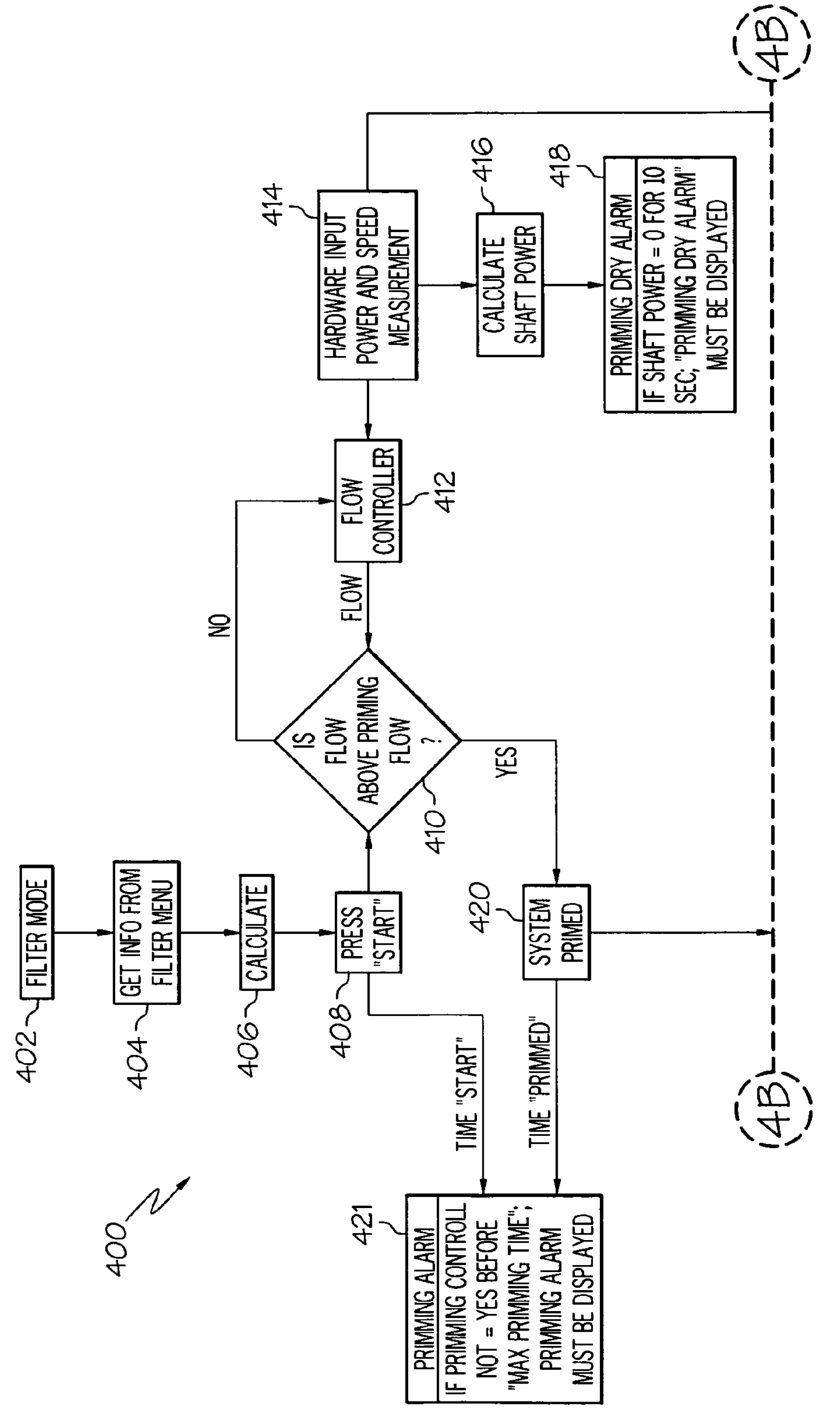
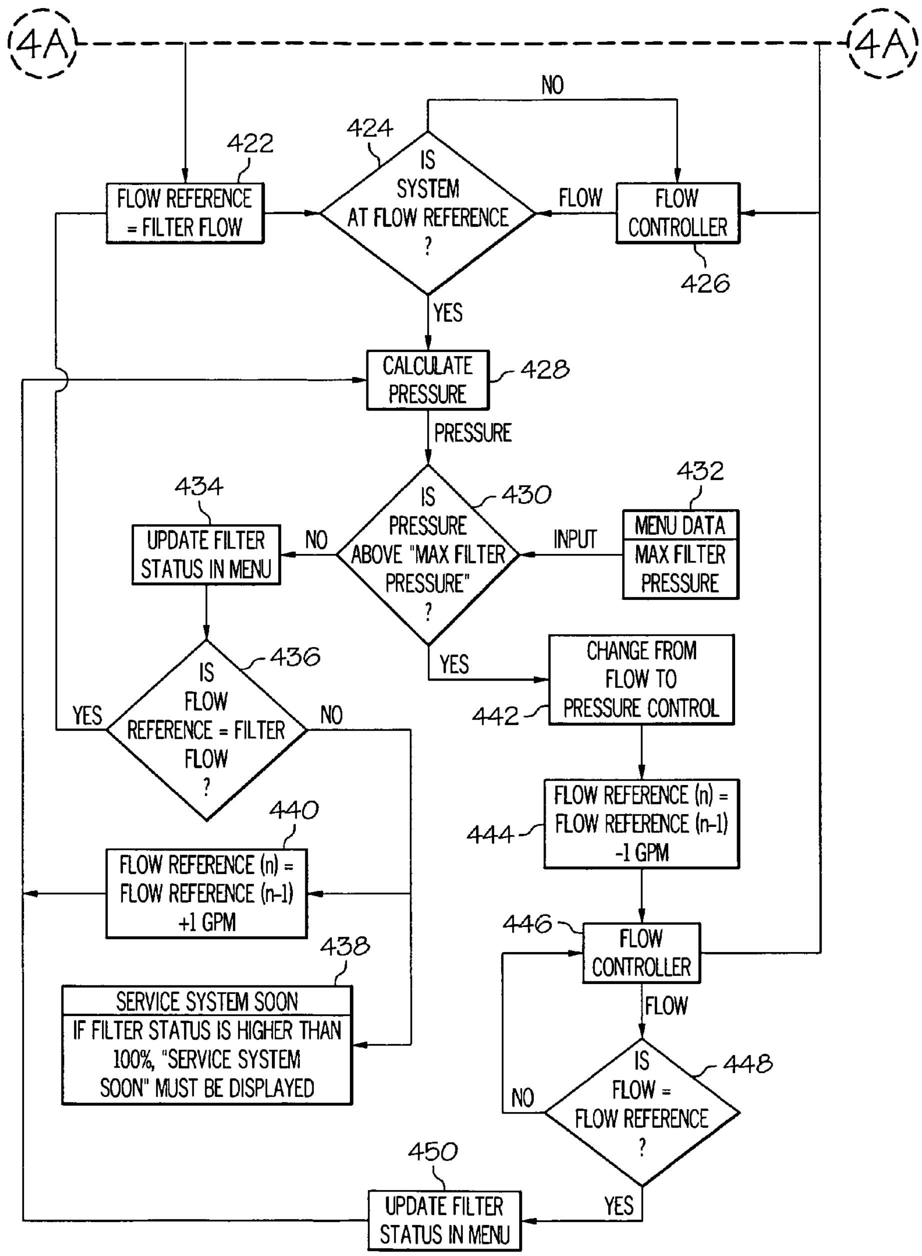

400
FILTER MODE
402
GET INFO FROM FILTER MENU
404
CALCULATE
406
PRESS "START"
408
IS FLOW ABOVE PRIMING FLOW ?
410
NO
YES
FLOW
FLOW CONTROLLER
412
HARDWARE INPUT POWER AND SPEED MEASUREMENT
414
CALCULATE SHAFT POWER
416
PRIMMING DRY ALARM
IF SHAFT POWER = 0 FOR 10 SEC; "PRIMMING DRY ALARM" MUST BE DISPLAYED
418
SYSTEM PRIMED
420
TIME "START"
TIME "PRIMMED"
PRIMMING ALARM
IF PRIMMING CONTROLL NOT = YES BEFORE "MAX PRIMMING TIME"; PRIMMING ALARM MUST BE DISPLAYED
421
4B
4B

FIG. 4A



4A
4A
NO
422
424
FLOW REFERENCE = FILTER FLOW
IS SYSTEM AT FLOW REFERENCE ?
FLOW
FLOW CONTROLLER
426
YES
CALCULATE PRESSURE
428
PRESSURE
432
434
IS PRESSURE ABOVE "MAX FILTER PRESSURE" ?
430
MENU DATA
MAX FILTER PRESSURE
INPUT
UPDATE FILTER STATUS IN MENU
NO
YES
CHANGE FROM FLOW TO PRESSURE CONTROL
442
436
IS FLOW REFERENCE = FILTER FLOW ?
YES
NO
FLOW REFERENCE (n) = FLOW REFERENCE (n-1) -1 GPM
444
440
FLOW REFERENCE (n) = FLOW REFERENCE (n-1) +1 GPM
446
FLOW CONTROLLER
438
SERVICE SYSTEM SOON
IF FILTER STATUS IS HIGHER THAN 100%, "SERVICE SYSTEM SOON" MUST BE DISPLAYED
FLOW
IS FLOW = FLOW REFERENCE ?
448
NO
450
UPDATE FILTER STATUS IN MENU
YES

FIG. 4B

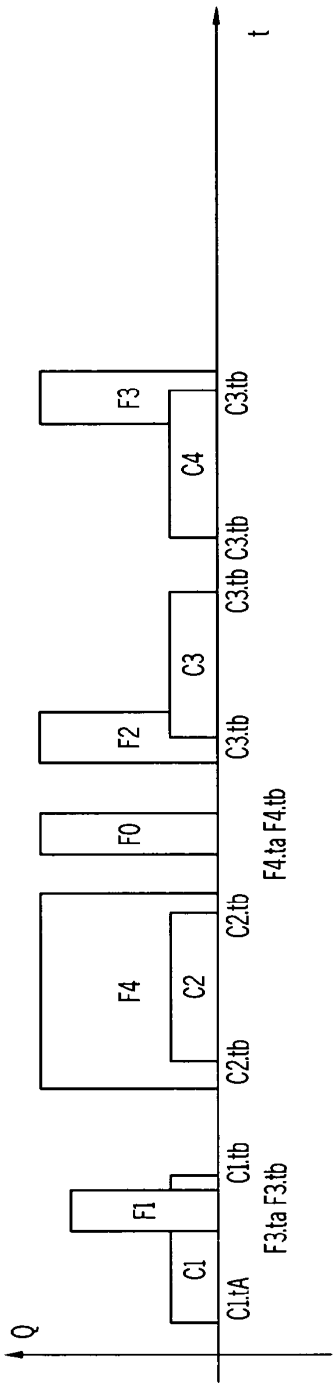

Q
t
C1
F1
C1.tA
F3.ta F3.tb
C1.tb
F4
C2
C2.tb
C2.tb
F0
F4.ta F4.tb
F2
C3
C3.tb
C3.tb C3.tb
C4
F3
C3.tb

FIG. 5A

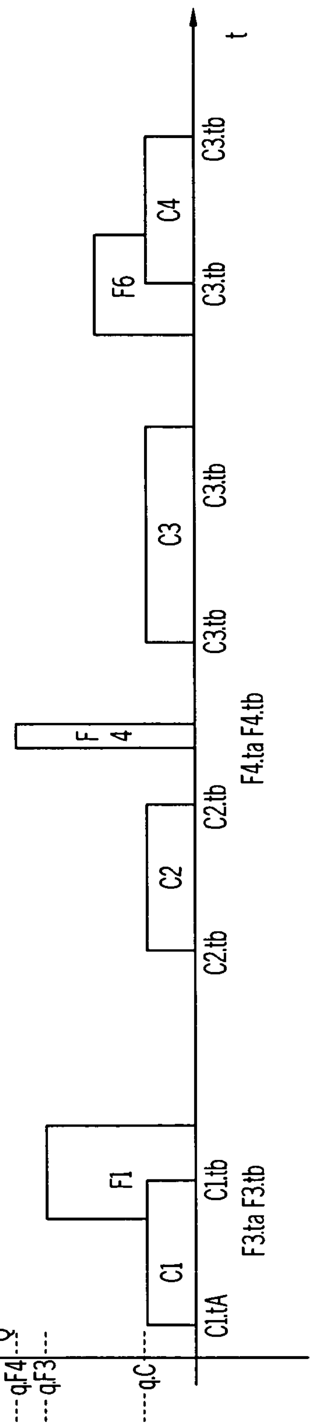

Q
t
qF4
qF3
qC
C1
F1
C1.tA
F3.ta F3.tb
C1.tb
C2
C2.tb
C2.tb
F
4
F4.ta F4.tb
C3
C3.tb
C3.tb
F6
C4
C3.tb
C3.tb

FIG. 5B

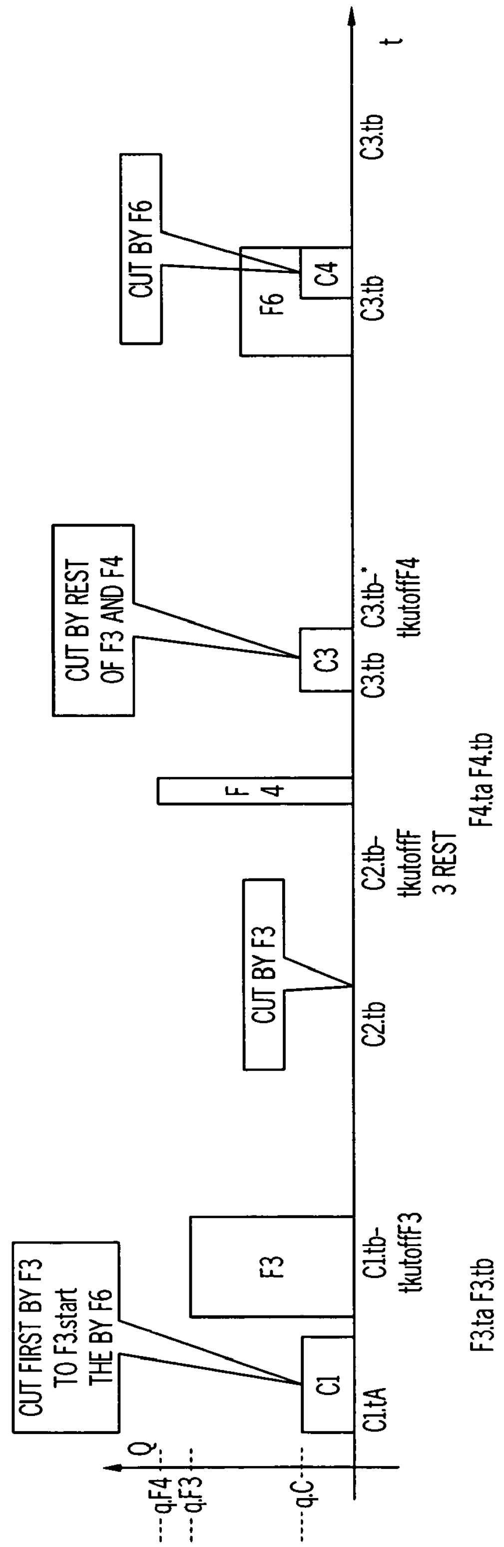

t
C3.tb
CUT BY F6
C4
F6
C3.tb
CUT BY REST
OF F3 AND F4
C3
C3.tb
C3.tb-*
tkutoffF4
F
4
F4.ta F4.tb
C2.tb-
tkutoffF
3 REST
CUT BY F3
C2.tb
F3
C1.tb-
tkutoffF3
F3.ta F3.tb
CUT FIRST BY F3
TO F3.start
THE BY F6
C1
C1.tA
Q
q.F4
q.F3
q.C

FIG. 5C

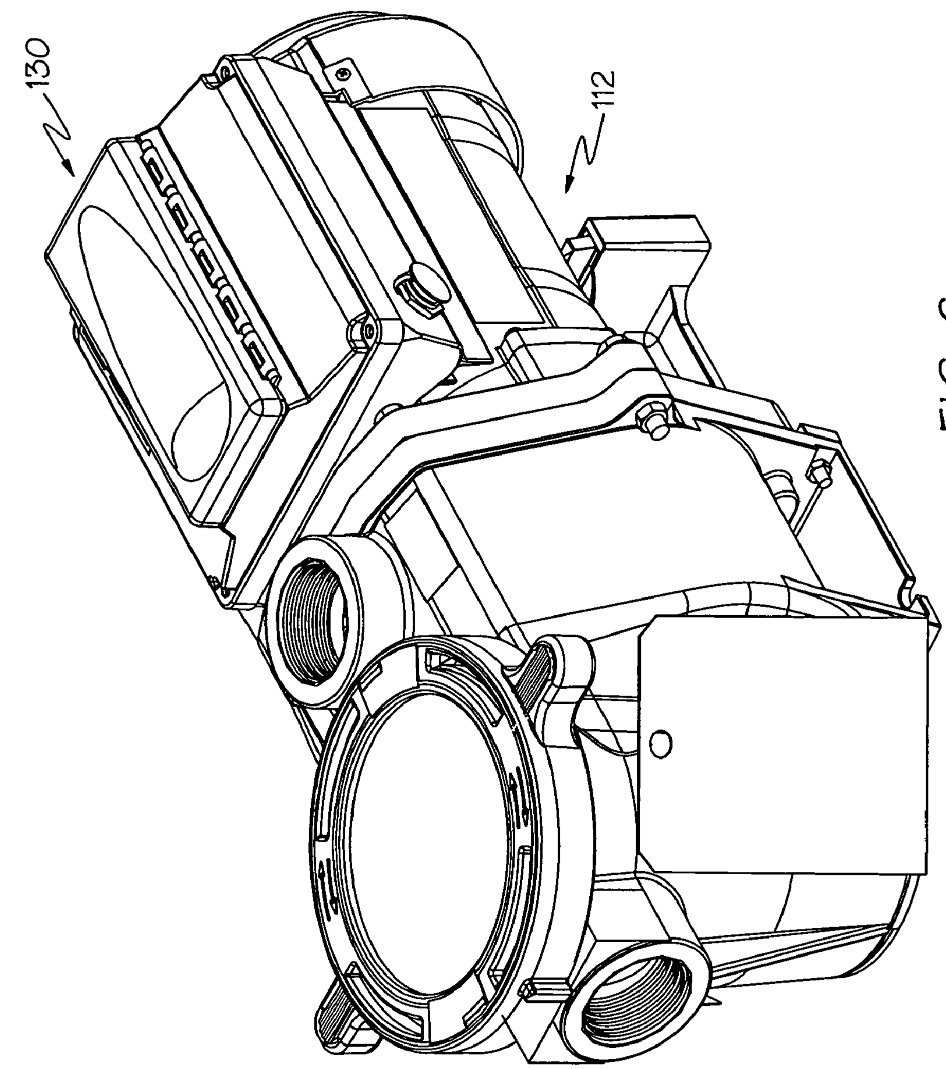


FIG. 6

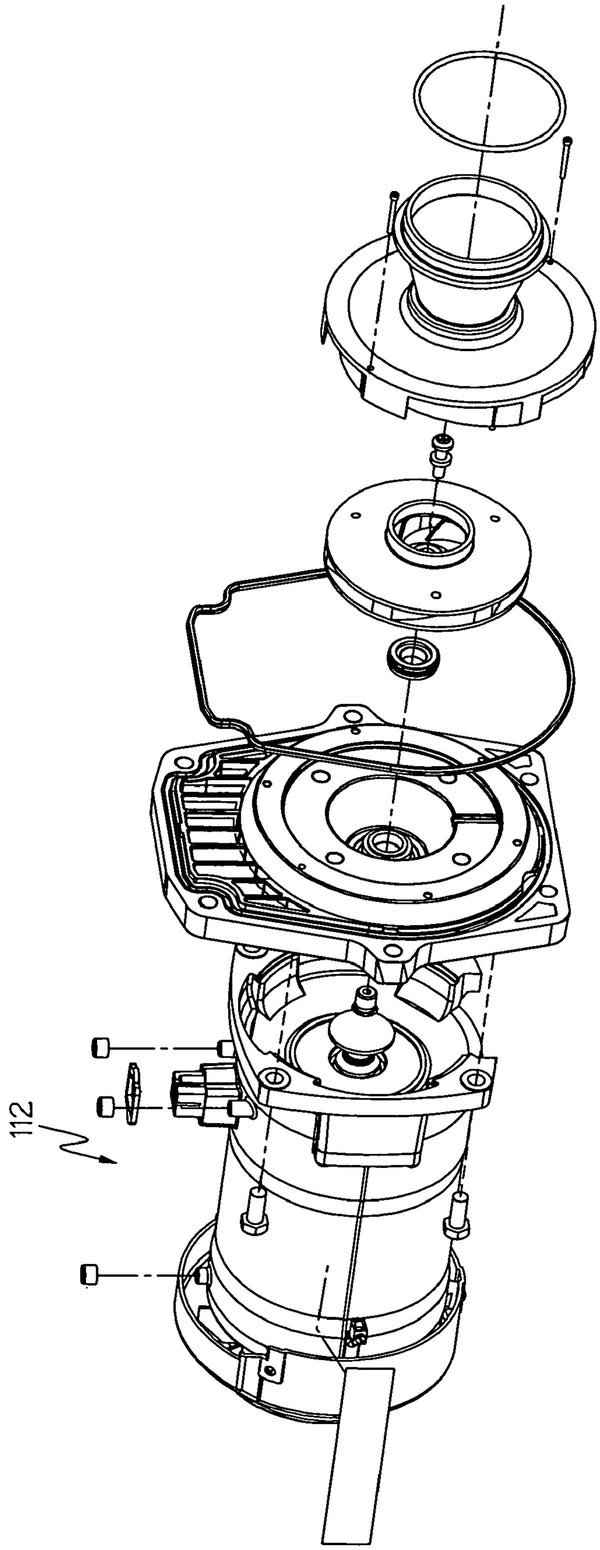


FIG. 7

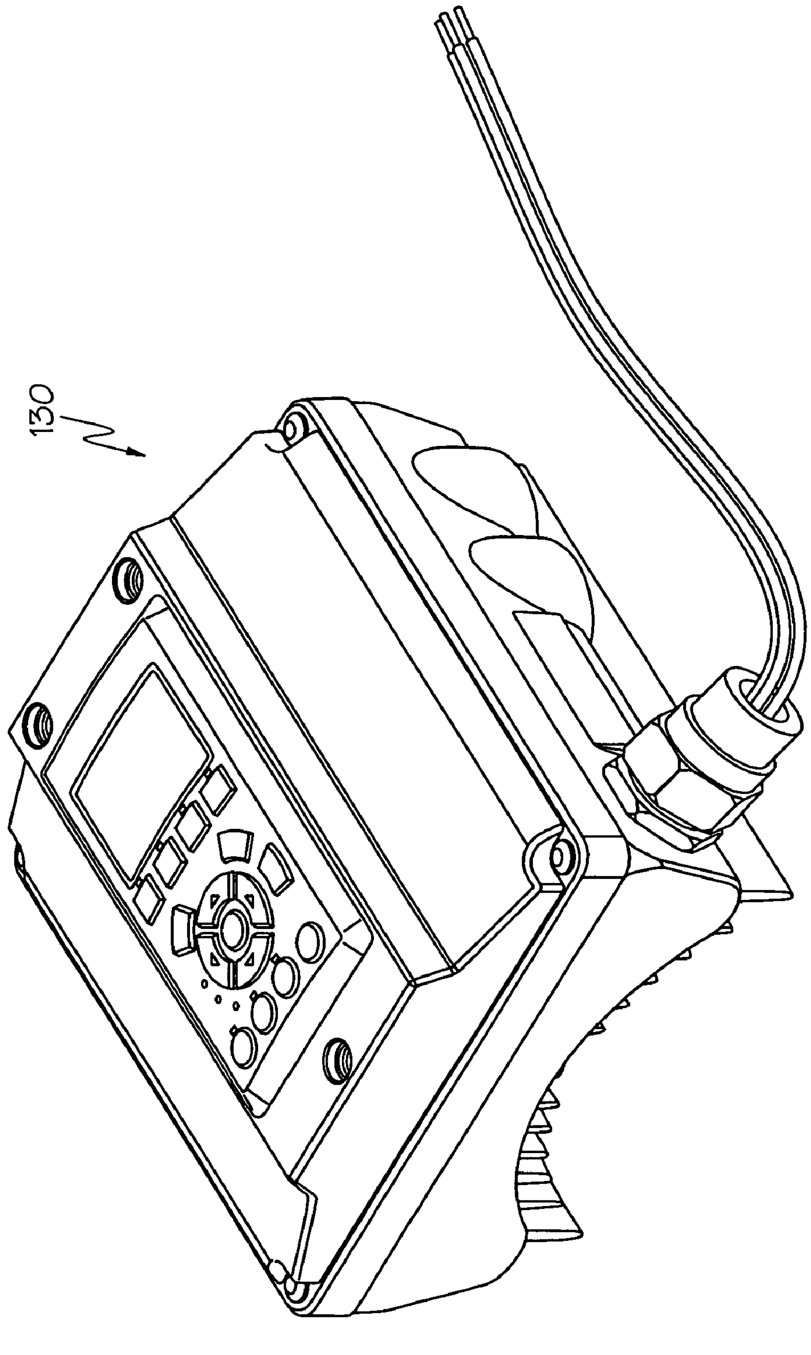


FIG. 8

CONTROL ALGORITHM OF VARIABLE SPEED PUMPING SYSTEM

This application is a continuation-in-part of U.S. patent application Ser. No. 10/926,513 filed on Aug. 26, 2004 now U.S. Pat. No. 7,874,808.

FIELD OF THE INVENTION

The present invention relates generally to control of a pump, and more particularly to control of a variable speed pumping system for a pool, a spa or other aquatic application.

BACKGROUND OF THE INVENTION

Conventionally, a pump to be used in an aquatic application such as a pool or a spa is operable at a finite number of predetermined speed settings (e.g., typically high and low settings). Typically these speed settings correspond to the range of pumping demands of the pool or spa at the time of installation. Factors such as the volumetric flow rate of water to be pumped, the total head pressure required to adequately pump the volume of water, and other operational parameters determine the size of the pump and the proper speed settings for pump operation. Once the pump is installed, the speed settings typically are not readily changed to accommodate changes in the pumping demands.

Installation of the pump for an aquatic application such as a pool entails sizing the pump to meet the pumping demands of that particular pool and any associated features. Because of the large variety of shapes and dimensions of pools that are available, precise hydraulic calculations must be performed by the installer, often on-site, to ensure that the pumping system works properly after installation. The hydraulic calculations must be performed based on the specific characteristics and features of the particular pool, and may include assumptions to simplify the calculations for a pool with a unique shape or feature. These assumptions can introduce a degree of error to the calculations that could result in the installation of an unsuitably sized pump. Essentially, the installer is required to install a customized pump system for each aquatic application.

A plurality of aquatic applications at one location requires a pump to elevate the pressure of water used in each application. When one aquatic application is installed subsequent to a first aquatic application, a second pump must be installed if the initially installed pump cannot be operated at a speed to accommodate both aquatic applications. Similarly, features added to an aquatic application that use water at a rate that exceeds the pumping capacity of an existing pump will need an additional pump to satisfy the demand for water. As an alternative, the initially installed pump can be replaced with a new pump that can accommodate the combined demands of the aquatic applications and features.

During use, it is possible that a conventional pump is manually adjusted to operate at one of the finite speed settings. Resistance to the flow of water at an intake of the pump causes a decrease in the volumetric pumping rate if the pump speed is not increased to overcome this resistance. Further, adjusting the pump to one of the settings may cause the pump to operate at a rate that exceeds a needed rate, while adjusting the pump to another setting may cause the pump to operate at a rate that provides an insufficient amount of flow and/or pressure. In such a case, the pump will either operate inefficiently or operate at a level below that which is desired.

Accordingly, it would be beneficial to provide a pump that could be readily and easily adapted to provide a suitably

supply of water at a desired pressure to aquatic applications having a variety of sizes and features. The pump should be customizable on-site to meet the needs of the particular aquatic application and associated features, capable of pumping water to a plurality of aquatic applications and features, and should be variably adjustable over a range of operating speeds to pump the water as needed when conditions change. Further, the pump should be responsive to a change of conditions and/or user input instructions.

SUMMARY OF THE INVENTION

In accordance with one aspect, the present invention provides a pumping system for moving water of an aquatic application. The pumping system includes a water pump for moving water in connection with performance of an operation upon the water and a variable speed motor operatively connected to drive the pump. The system includes means for determining a value indicative of flow rate of water moved by the pump, and means for controlling the motor to adjust the flow rate indicative value toward a constant. The system includes means for determining a value indicative of flow pressure of water moved by the pump, and means for controlling the motor to adjust the flow pressure indicative value toward a constant. The system includes means for selecting between flow rate control and flow pressure control.

In accordance with another aspect, the present invention provides a pumping system for moving water of an aquatic application. The pumping system includes a water pump for moving water, and a variable speed motor operatively connected to drive the pump. The system includes means for controlling the motor to adjust motor output, means for performing a first operation upon the moving water, and means for performing a second operation upon the moving water. The system includes means for using control parameters for the motor during the first operation based upon a target water volume, and means for determining volume of water moved by the pump during a time period. The system also includes means for changing the control parameters used for the first operation dependent upon performance of the second operation during the time period.

In accordance with another aspect, the present invention provides a pumping system for moving water of an aquatic application. The pumping system includes a water pump for moving water in connection with performance of an operation upon the water and a variable speed motor operatively connected to drive the pump. The system includes means for determining flow rate of water moved by the pump, and means for controlling the motor to adjust the flow rate toward a constant flow rate value. The system includes means for determining flow pressure of water moved by the pump, and means for controlling the motor to adjust the flow pressure toward a constant flow pressure value. The system includes means for selecting between flow rate control and flow pressure control.

In accordance with yet another aspect, the present invention provides a pumping system for moving water of an aquatic application. The pumping system includes a water pump for moving water, and means for controlling operation of the pump to perform a first water operation with at least one predetermined parameter. The system includes means for operating the pump to perform a second water operation, and means for altering control of operation of the pump to perform the first water operation to vary the at least one parameter in response to operation of the pump to perform the second operation.

In accordance with yet another aspect, the present invention provides a pumping system for moving water of an aquatic application. The pumping system includes a water pump for moving water, and means for controlling a routine filter cycle. The system includes means for operating the pump to perform an additional water operation, and means for altering the routine filter cycle in response to operation of the pump to perform the additional water operation.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features and advantages of the present invention will become apparent to those skilled in the art to which the present invention relates upon reading the following description with reference to the accompanying drawings, in which:

FIG. **1** is a block diagram of an example of a variable speed pumping system in accordance with the present invention with a pool environment;

FIG. **2** is another block diagram of another example of a variable speed pumping system in accordance with the present invention with a pool environment;

FIG. **3** is a function flow chart for an example methodology in accordance with the present invention;

FIGS. **4**A and **4**B are a flow chart for an example of a process in accordance with an aspect of the present invention;

FIGS. **5**A-**5**C are time lines showing operations that may be performed via a system in accordance with the present;

FIG. **6** is a perceptive view of an example pump unit that incorporates the present invention;

FIG. **7** is a perspective, partially exploded view of a pump of the unit shown in FIG. **6**; and

FIG. **8** is a perspective view of a controller unit of the pump unit shown in FIG. **6**.

DESCRIPTION OF EXAMPLE EMBODIMENTS

Certain terminology is used herein for convenience only and is not to be taken as a limitation on the present invention. Further, in the drawings, the same reference numerals are employed for designating the same elements throughout the figures, and in order to clearly and concisely illustrate the present invention, certain features may be shown in somewhat schematic form.

An example variable-speed pumping system **10** in accordance with one aspect of the present invention is schematically shown in FIG. **1**. The pumping system **10** includes a pump unit **12** that is shown as being used with a pool **14**. It is to be appreciated that the pump unit **12** includes a pump **16** for moving water through inlet and outlet lines **18** and **20**.

The pool **14** is one example of an aquatic application with which the present invention may be utilized. The phrase "aquatic application" is used generally herein to refer to any reservoir, tank, container or structure, natural or man-made, having a fluid, capable of holding a fluid, to which a fluid is delivered, or from which a fluid is withdrawn. Further, "aquatic application" encompasses any feature associated with the operation, use or maintenance of the aforementioned reservoir, tank, container or structure. This definition of "aquatic application" includes, but is not limited to pools, spas, whirlpool baths, landscaping ponds, water jets, waterfalls, fountains, pool filtration equipment, pool vacuums, spillways and the like. Although each of the examples provided above includes water, additional applications that include liquids other than water are also within the scope of the present invention. Herein, the terms pool and water are used with the understanding that they are not limitations on the present invention.

A water operation **22** is performed upon the water moved by the pump **16**. Within the shown example, water operation **22** is a filter arrangement that is associated with the pumping system **10** and the pool **14** for providing a cleaning operation (i.e., filtering) on the water within the pool. The filter arrangement **22** is operatively connected between the pool **14** and the pump **16** at/along an inlet line **18** for the pump. Thus, the pump **16**, the pool **14**, the filter arrangement **22**, and the interconnecting lines **18** and **20** form a fluid circuit or pathway for the movement of water.

It is to be appreciated that the function of filtering is but one example of an operation that can be performed upon the water. Other operations that can be performed upon the water may be simplistic, complex or diverse. For example, the operation performed on the water may merely be just movement of the water by the pumping system (e.g., re-circulation of the water in a waterfall or spa environment).

Turning to the filter arrangement **22**, any suitable construction and configuration of the filter arrangement is possible. For example, the filter arrangement **22** may include a skimmer assembly for collecting coarse debris from water being withdrawn from the pool, and one or more filter components for straining finer material from the water.

The pump **16** may have any suitable construction and/or configuration for providing the desired force to the water and move the water. In one example, the pump **16** is a common centrifugal pump of the type known to have impellers extending radially from a central axis. Vanes defined by the impellers create interior passages through which the water passes as the impellers are rotated. Rotating the impellers about the central axis imparts a centrifugal force on water therein, and thus imparts the force flow to the water. Although centrifugal pumps are well suited to pump a large volume of water at a continuous rate, other motor-operated pumps may also be used within the scope of the present invention.

Drive force is provided to the pump **16** via a pump motor **24**. In the one example, the drive force is in the form of rotational force provided to rotate the impeller of the pump **16**. In one specific embodiment, the pump motor **24** is a permanent magnet motor. In another specific embodiment, the pump motor **24** is a three-phase motor. The pump motor **24** operation is infinitely variable within a range of operation (i.e., zero to maximum operation). In one specific example, the operation is indicated by the RPM of the rotational force provided to rotate the impeller of the pump **16**.

A controller **30** provides for the control of the pump motor **24** and thus the control of the pump **16**. Within the shown example, the controller **30** includes a variable speed drive **32** that provides for the infinitely variable control of the pump motor **24** (i.e., varies the speed of the pump motor). By way of example, within the operation of the variable speed drive **32**, a single phase AC current from a source power supply is converted (e.g., broken) into a three-phase DC current. Any suitable technique and associated construction/configuration may be used to provide the three-phase DC current. For example, the construction may include capacitors to correct line supply over or under voltages. The variable speed drive supplies the DC electric power at a changeable frequency to the pump motor to drive the pump motor. The construction and/or configuration of the pump **16**, the pump motor **24**, the controller **30** as a whole, and the variable speed drive **32** as a portion of the controller **30**, are not limitations on the present invention. In one possibility, the pump **16** and the pump motor **24** are disposed within a single housing to form a single unit,

and the controller **30** with the variable speed drive **32** are disposed within another single housing to form another single unit. In another possibility, these components are disposed within a single housing to form a single unit.

The pumping system **10** has means used for control of the operation of the pump. In accordance with one aspect of the present invention, the pumping system **10** includes means for sensing, determining, or the like one or more parameters indicative of the operation performed upon the water. Within one specific example, the system includes means for sensing, determining or the like one or more parameters indicative of the movement of water within the fluid circuit.

The ability to sense, determine or the like one or more parameters may take a variety of forms. For example, one or more sensors **34** may be utilized. Such one or more sensors **34** can be referred to as a sensor arrangement. The sensor arrangement **34** of the pumping system **10** would sense one or more parameters indicative of the operation performed upon the water. Within one specific example, the sensor arrangement **34** senses parameters indicative of the movement of water within the fluid circuit. The movement along the fluid circuit includes movement of water through the filter arrangement **22**. As such, the sensor arrangement **34** includes at least one sensor used to determine flow rate of the water moving within the fluid circuit and/or includes at least one sensor used to determine flow pressure of the water moving within the fluid circuit. In one example, the sensor arrangement **34** is operatively connected with the water circuit at/adjacent to the location of the filter arrangement **22**. It should be appreciated that the sensors of the sensor arrangement **34** may be at different locations than the locations presented for the example. Also, the sensors of the sensor arrangement **34** may be at different locations from each other. Still further, the sensors may be configured such that different sensor portions are at different locations within the fluid circuit. Such a sensor arrangement **34** would be operatively connected **36** to the controller **30** to provide the sensory information thereto.

It is to be noted that the sensor arrangement **34** may accomplish the sensing task via various methodologies, and/or different and/or additional sensors may be provided within the system **10** and information provided therefrom may be utilized within the system. For example, the sensor arrangement **34** may be provided that is associated with the filter arrangement and that senses an operation characteristic associated with the filter arrangement. For example, such a sensor may monitor filter performance. Such monitoring may be as basic as monitoring filter flow rate, filter pressure, or some other parameter that indicates performance of the filter arrangement. Of course, it is to be appreciated that the sensed parameter of operation may be otherwise associated with the operation performed upon the water. As such, the sensed parameter of operation can be as simplistic as a flow indicative parameter such as rate, pressure, etc.

Such indication information can be used by the controller **30**, via performance of a program, algorithm or the like, to perform various functions, and examples of such are set forth below. Also, it is to be appreciated that additional functions and features may be separate or combined, and that sensor information may be obtained by one or more sensors.

With regard to the specific example of monitoring flow rate and flow pressure, the information from the sensor arrangement **34** can be used as an indication of impediment or hindrance via obstruction or condition, whether physical, chemical, or mechanical in nature, that interferes with the flow of water from the aquatic application to the pump such as debris accumulation or the lack of accumulation, within the filter arrangement **34**. As such, the monitored information is indicative of the condition of the filter arrangement.

Within another example (FIG. **2**) of a pumping system **110** that includes means for sensing, determining, or the like one or more parameters indicative of the operation performed upon the water, the controller **130** can determine the one or more parameters via sensing, determining or the like parameters associated with the operation of a pump **116** of a pump unit **112**. Such an approach is based upon an understanding that the pump operation itself has one or more relationships to the operation performed upon the water.

It should be appreciated that the pump unit **112**, which includes the pump **116** and a pump motor **124**, a pool **114**, a filter arrangement **122**, and interconnecting lines **118** and **120**, may be identical or different from the corresponding items within the example of FIG. **1**.

Turning back to the example of FIG. **2**, some examples of the pumping system **110**, and specifically the controller **130** and associated portions, that utilize at least one relationship between the pump operation and the operation performed upon the water attention are shown in U.S. Pat. No. 6,354,805, to Moller, entitled "Method For Regulating A Delivery Variable Of A Pump" and U.S. Pat. No. 6,468,042, to Moller, entitled "Method For Regulating A Delivery Variable Of A Pump." The disclosures of these patents are incorporated herein by reference. In short summary, direct sensing of the pressure and/or flow rate of the water is not performed, but instead one or more sensed or determined parameters associated with pump operation are utilized as an indication of pump performance. One example of such a pump parameter is input power. Pressure and/or flow rate can be calculated/determined from such pump parameter(s).

Although the system **110** and the controller **130** there may be of varied construction, configuration and operation, the function block diagram of FIG. **2** is generally representative. Within the shown example, an adjusting element **140** is operatively connected to the pump motor and is also operatively connected to a control element **142** within the controller **130**. The control element **142** operates in response to a comparative function **144**, which receives input from a power calculation **146**.

The power calculation **146** is performed utilizing information from the operation of the pump motor **124** and controlled by the adjusting element **140**. As such, a feedback iteration is performed to control the pump motor **124**. Also, it is the operation of the pump motor and the pump that provides the information used to control the pump motor/pump. As mentioned, it is an understanding that operation of the pump motor/pump has a relationship to the flow rate and/or pressure of the water flow that is utilized to control flow rate and/or flow pressure via control of the pump.

As mentioned, the sensed, determined (e.g., calculated, provided via a look-up table, etc.), etc. information is utilized to determine the flow rate and/or the flow pressure. In one example, the operation is based upon an approach in which the pump (e.g., **16** or **116**) is controlled to operate at a lowest amount that will accomplish the desired task (e.g., maintain a desired filtering level of operation) via a constant flow rate. Specifically, as the sensed parameter changes, the lowest level of pump operation (i.e., pump speed) to accomplish the desired task will need to change. The controller (e.g., **30** or **130**) provides the control to operate the pump motor/pump accordingly. In other words, the controller (e.g., **30** or **130**) repeatedly adjusts the speed of the pump motor (e.g., **24** or **124**) to a minimum level responsive to the sensed/determined parameter to maintain operation at a specific level. Such an operation mode can provide for minimal energy usage.

Turning to the issue of operation of the system (e.g., **10** or **110**) over a course of a long period of time, it is typical that a predetermined volume of water flow is desired. For example, it may be desirable to move a volume of water equal to the volume within the aquatic application (e.g., pool or spa). Such movement of water is typically referred to as a turnover. It may be desirable to move a volume of water equal to multiple turnovers within a specified time period (e.g., a day). Within an example in which the water operation includes a filter operation, the desired water movement (e.g., specific number of turnovers within one day) may be related to the necessity to maintain a desired water clarity.

Within the water operation that contains a filter operation, the amount of water that can be moved and/or the ease by which the water can be moved is dependent in part upon the current state (e.g., quality) of the filter arrangement. In general, a dean (e.g., new, fresh) filter arrangement provides a lesser impediment to water flow than a filter arrangement that has accumulated filter matter (e.g., dirty). For a constant flow rate through a filter arrangement, a lesser pressure is required to move the water through a clean filter arrangement than a pressure that is required to move the water through a dirty filter arrangement. Another way of considering the effect of dirt accumulation is that if pressure is kept constant then the flow rate will decrease as the dirt accumulates and hinders (e.g., progressively blocks) the flow.

Turning to one aspect that is provided by the present invention, the system can operate to maintain a constant flow of water within the circuit. Maintenance of constant flow is useful in the example that includes a filter arrangement. Moreover, the ability to maintain a constant flow is useful when it is desirable to achieve a specific flow volume during a specific period of time. For example, it may be desirable to filter pool water and achieve a specific number of water turnovers within each day of operation to maintain a desired water clarity despite the fact that the filter arrangement will progressively increase dirt accumulation.

It should be appreciated that maintenance of a constant flow volume despite an increasing impediment caused by filter dirt accumulation requires an increasing pressure and is the result of increasing motive force from the pump/motor. As such, one aspect of the present invention is to control the motor/pump to provide the increased motive force that provides the increased pressure to maintain the constant flow.

Of course, continuous pressure increase to address the increase in filter dirt impediment is not useful beyond some level. As such, in accordance with another aspect of the present invention, the system (e.g., **10** or **110**) controls operation of the motor/pump such that the motive force is not increased and the flow rate is thus not maintained constant. In one example, the cessation of increases in motive force occurs once a specific pressure level (e.g., a threshold) is reached. A pressure level threshold may be related to a specific filter type, system configuration, etc. In one specific example, the specific pressure level threshold is predetermined. Also, within one specific example, the specific pressure level threshold may be a user or technician-entered parameter.

Within another aspect of the present invention, the system (e.g., **10** or **110**) may operate to reduce pressure while the pressure is above the pressure level threshold. Within yet another, related aspect of the present invention, the system (e.g., **10** or **110**) may return to control of the flow rate to maintain a specific, constant flow rate subsequent to the pressure being reduced below the pressure level threshold.

Within yet another aspect of the present invention, the system (e.g., **10** or **110**) may operate to have different constant flow rates during different time periods. Such different time periods may be sub-periods (e.g., specific hours) within an overall time period (e.g., a day) within which a specific number of water turnovers is desired. During some time periods a larger flow rate may be desired, and a lower flow rate may be desired at other time periods. Within the example of a swimming pool with a filter arrangement as part of the water operation, it may be desired to have a larger flow rate during pool-use time (e.g., daylight hours) to provide for increased water turnover and thus increased filtering of the water. Within the same swimming pool example, it may be desired to have a lower flow rate during non-use (e.g., nighttime hours).

Turning to one specific example, attention is directed to the top-level operation chart that is shown in FIG. **3**. With the chart, it can be appreciated that the system has an overall ON/OFF status **302** as indicated by the central box. Specifically, overall operation is started **304** and thus the system is ON. However, under the penumbra of a general ON state, a number of modes of operation can be entered. Within the shown example, the modes are Vacuum run **306**, Manual run **308**, Filter **310**, and Cleaning sequence **312**.

Briefly, the Vacuum run mode **306** is entered and utilized when a vacuum device is utilized within the pool (e.g., **14** or **114**). For example, such a vacuum device is typically connected to the pump (e.g., **16** or **116**), possibly through the filter arrangement, (e.g., **22** or **122**) via a relative long extent of hose and is moved about the pool (e.g., **14** or **114**) to clean the water at various locations and/or the surfaces of the pool at various locations. The vacuum device may be a manually moved device or may autonomously move.

Similarly, the manual run mode **308** is entered and utilized when it is desired to operate the pump outside of the other specified modes. The cleaning sequence mode **312** is for operation performed in the course of a cleaning routine.

Turning to the filter mode **310**, this mode is a typical operation mode in order to maintain water clarity within the pool (e.g., **14** or **114**). Moreover, the filter mode **310** is operated to obtain effective filtering of the pool while minimizing energy consumption. As one example of the filter mode **310**, attention is directed to the flow chart of FIG. **4** that shows an example process **400** for accomplishing a filter function within the filter mode. Specifically, the pump is operated to move water through the filter arrangement. It is noted that the example process is associated with the example of FIG. **2**. However, it is to be appreciated that a similar process occurs associated with the example of FIG. **1**.

The process **400** (FIG. **4**) is initiated at step **402** and proceeds to step **404**. At step **404** information is retrieved from a filter menu. The information may take a variety of forms and may have a variety of contents. As one example, the information includes cycles of circulation of the water per day, turnovers per day, scheduled time (e.g., start and stop times for a plurality of cycles), pool size, filter pressure before achieving a service systems soon status, and maximum priming time. It should be appreciated that such information (e.g., values) is desired and/or intended, and/or preselected/predetermined.

Subsequent to step **404**, the process **400** proceeds to step **406** in which one or more calculations are performed. For example, a filter flow value is determined based upon a ratio of pool size to scheduled time (e.g., filter flow equals pool size divided by scheduled time). Also, the new off time may be calculated for the scheduled time (e.g., a cut off time). Next, the process **400** proceeds to step **408** in which a “START” is activated to begin repetitive operation of the filter mode.

The process **400** proceeds from step **408** to step **410** in which it is determined whether the flow is above a priming flow value. If the determination at step **410** is negative (e.g.,

the flow is not above a priming flow value), the process **400** proceeds to step **412**. Within step **412**, the flow control process is performed. As mentioned above, the flow control process may be similar to the process disclosed within U.S. Pat. No. 6,354,805 or U.S. Pat. No. 6,468,042. It should be noted that step **414** provides input that is utilized within step **412**. Specifically, hardware input such as power and speed measurement are provided. This information is provided via a hardware input that can give information in a form of current and/or voltage as an indication of power and speed measurement of the pump motor. Associated with step **414** is step **416** in which shaft power provided by the pump motor is calculated. At step **418**, a priming dry alarm step is provided. In one example, if the shaft power is zero for ten seconds, a priming dry alarm is displayed and the process **400** is interrupted and does not proceed any further until the situation is otherwise corrected.

Returning to step **412**, it should be appreciated that subsequent to operation of the step **412**, the process **400** returns to step **410** in which the query concerning the flow being above a priming flow is repeated. If the determination within step **410** is affirmative (i.e., the flow is above the priming flow value), the process **400** proceeds from step **410** to step **420**.

It should be appreciated that steps **408** and **420** provide two bits of information that is utilized within an ancillary step **421**. Specifically, step **408** provides a time start indication and step **420** provides a time primed indication. Within step **421**, a determination concerning a priming alarm is made. Specifically, if priming control (i.e., the system is determined to be primed), is not reached prior to a maximum priming time allotment, a priming alarm is displayed, and the process **400** is interrupted and does not proceed any further until the situation is addressed and corrected.

Returning to step **420**, the process **400** proceeds from step **420** to step **422** in which a flow reference is set equal to the current filter flow value. Subsequent to step **422**, the process **400** proceeds to step **424**. At step **424**, it is determined whether the system is operating at a specified flow reference. The filter flow is defined in terms of volume based upon time. If the determination at step **424** is negative (i.e., the system is not operating at the flow reference level), the process **400** proceeds to step **426**. At step **426**, the flow control process is performed, similar to step **412**. As such, step **414** also provides input that is utilized within step **426**. Subsequent to step **426**, the process returns to step **424**.

If the determination with step **424** is affirmative (i.e., the system is operating at the flow reference level), the process **400** proceeds to step **428** in which pressure is calculated. Pressure can be calculated based upon information derived from operation of the pump. Subsequent to step **428**, the process **400** proceeds to step **430**. At **430**, a determination is made as to whether the pressure is above a maximum filter pressure.

It should be noted that step **432** of the process **400** provides input to the determination within the step **430**. Specifically, at step **432** a menu of data that contains a maximum filter pressure value is accessed. If the determination at step **430**, is negative (i.e., the pressure is not above the maximum filter pressure), the process **400** proceeds to step **434**. At step **434**, the filter status is updated in the menu memory. Subsequent to step **434**, the process **400** proceeds to step **436**.

At step **436**, a determination is made as to whether the flow reference is equal to the filter flow. If the determination as step **436** is affirmative (i.e., the flow reference is equal to the filter flow), the process **400** loops back to step **422**. However, if the determination at step **436** is negative (i.e., the flow reference is not equal to the filter flow), the process **400** proceeds to steps **438** and **440**.

Within step **438**, a determination is made as to whether the filter status is higher than 100%. If so, a service system soon indication is displayed. At step **440**, a flow reference at reference N is readjusted to equal a previous flow reference (i.e., N−1 plus a specific value). Within the shown example, the additional value is 1 gallon per minute. Subsequent to the adjustment of the flow reference, the process **400** proceeds to step **428** for repeat of step **428** and at least some of the subsequent process steps.

Focusing again upon step **430**, if the determination at step **430** is affirmative (i.e., the pressure is above the maximum filter pressure), the process **400** proceeds from step **430** to step **442**. At step **442**, the process **400** changes from flow control to pressure control. Specifically, it is to be appreciated that up to this time, the process **400** has attempted to maintain the flow rate at an effectively constant value. However, from step **442**, the process **400** will attempt to maintain the flow pressure at effectively a constant value.

The process **400** proceeds from step **442** to step **444**. Within step **444**, a flow reference value is adjusted. Specifically, the flow reference value for time index N is set equal to the flow reference value for time index N−1 that has been decreased by a predetermined value. Within this specific example, the decreased value is 1 gallon per minute. Subsequent to step **444**, the process **400** proceeds to step **446** in which the flow controller, as previously described, performs its function. Similar to the steps **412** and **426**, step **446** obtains hardware input. For example, power and speed measuring information is provided for use within the flow controller. Subsequent to step **446**, the process **400** proceeds to step **448**.

Within the step **448** a determination is made as to whether the flow equals a flow reference. If the determination within step **448** is negative (i.e., the flow does not equal the flow reference), the process **400** proceeds from step **448** back to step **446**. However, if the determination within step **448** is affirmative (i.e., the flow is equal to the flow reference), the process **400** proceeds from step **448** to step **450**. Within step **450**, the status of filter arrangement is updated within the memory of the menu. Subsequent to step **450**, the process **400** proceeds back to step **428** and at least some of the subsequent steps are repeated.

One of the advantages provided by the example shown within FIG. **4** is that a minimum amount of energy is extended to maintain a constant flow so long as the filter arrangement does not provide an excessive impediment to flow of water. However, subsequent to the filter arrangement becoming a problem to constant flow (e.g., the filter arrangement is sufficiently clogged), the methodology provides for a constant pressure to be maintained to provide for at least some filtering function despite an associated decrease in flow. Moreover, the process is iterative to constantly adjust the flow or the pressure to maintain a high efficiency coupled with a minimal energy usage.

In accordance with another aspect, it should be appreciated that the filtering function, as a free standing operation, is intended to maintain clarity of the pool water. However, it should be appreciated that the pump (e.g., **16** or **116**) may also be utilized to operate other functions and devices such as a separate cleaner, a water slide, or the like. The example of FIG. **1** shows an example additional operation **38** and the example of FIG. **2** shows an example additional operation **138**. Such an additional operation (e.g., **38** or **138**) may be a cleaner device, either manual or autonomous. As can be appreciated, an additional operation involves additional water

movement. Also, within the presented examples of FIGS. **1** and **2**, the water movement is through the filter arrangement (e.g., **22** or **122**). Such, additional water movement may be used to supplant the need for other water movement, in accordance with one aspect of the present invention and as described further below.

Associated with such other functions and devices is a certain amount of water movement. The present invention, in accordance with one aspect, is based upon an appreciation that such other water movement may be considered as part of the overall desired water movement, cycles, turnover, filtering, etc. As such, water movement associated with such other functions and devices can be utilized as part of the overall water movement to achieve desired values within a specified time frame. Utilizing such water movement can allow for minimization of a purely filtering aspect. This permits increased energy efficiency by avoiding unnecessary pump operation.

FIG. **5**A is an example time line that shows a typical operation that includes both filter cycles (C**1**-C**4**) and several various other operations and/or devices (F**0**-F**4**) that are operated. It should be appreciated that pump operation for all of these cycles, functions, and devices would be somewhat wasteful. As such, the present invention provides a means to reduce a routine filtration cycle (e.g., C**1**-C**4**) in response to occurrence of one or more operations (e.g., F**0**-F**4**). Below are a series of equations that check for overlap and cutoff based upon utilization of all of the features (routine filtration cycles, C**1**-C**4**, and all other operations, F**0**-F**4**).

Overlap check and "cutoff" calculations for features for: all F's and C's

case F**0** type: (Fx.start<Cx.start & Fx.stop<Cx.start)|(Fx.start>Cx.stop & Fx.stop>Cx.stop)
 cutOff+=0

case F**1** type: Fx.start>Cx.start & Fx.stop<Cx.stop
 cutOff+=Fx.stop−Fx.start

case F**2** type: Fx.start<Cx.start & Fx.stop<Cx.stop & Fx.stop>Cx.start
 cutOff+=Fx.stop−Cx.start

case F**3** type: Fx.start>Cx.start & Fx.start<Cx.stop & Fx.stop>Cx.stop
 cutOff+=Cx.stop−Fx.start

case F**4** type: Fx.start<Cx.start & Fx.stop>Cx.stop
 cutOff+=Cx.stop−Cx.start

An example of how the routine filtration cycles are reduced is shown via a comparison of FIGS. **5**B and **5**C. Specifically, FIG. **5**B shows the cycles for routine filtration (C**1**-C**2**) and three other pump operation routines (e.g., F**3**, F**4**, and F**6**). As to be appreciated, because the other operations (F**3**, F**4**, and F**6**) will provide some of the necessary water movement, the routine filtration cycles can be reduced or otherwise eliminated. The equations set forth below provide an indication of how the routine filtration cycles can be reduced or eliminated.

```
k=q x t , konst = flow × time
For (all F's with k>0){
        krestF = k
        for (all C's)
  if FTstart > CTstart & FTstart < CTstop)
        krestF + kF − k(CTb − Fta)
else
        if (krestF < krestC)
        krestC = krestC − krestF
        CTstop = CTstart + (krestC/qC)
```


-continued

$$Cq = \frac{Ck}{CTstop - CTstart}$$

```
else
        krestF = krestF − krestC
        delete C
```

FIG. **5**C shows how the routine filtration cycles C**1**-C**4** are reduced or eliminated. It should be appreciated that the other functions (F**3**, F**4**, and F**6** remain).

Focusing on the aspect of minimal energy usage, within some know pool filtering applications, it is common to operate a known pump/filter arrangement for some portion (e.g., eight hours) of a day at effectively a very high speed to accomplish a desired level of pool cleaning. With the present invention, the system (e.g., **10** or **110**) with the associated filter arrangement (e.g., **22** or **122**) can be operated continuously (e.g., 24 hours a day, or some other time amount(s)) at an ever-changing minimum level to accomplish the desired level of pool cleaning. It is possible to achieve a very significant savings in energy usage with such a use of the present invention as compared to the known pump operation at the high speed. In one example, the cost savings would be in the range of 90% as compared to a known pump/filter arrangement.

Accordingly, one aspect of the present invention is that the pumping system controls operation of the pump to perform a first water operation with at least one predetermined parameter. The first operation can be routine filtering and the parameter may be timing and or water volume movement (e.g., flow rate or pressure). The pump can also be operated to perform a second water operation, which can be anything else besides just routine filtering (e.g., cleaning). However, in order to provide for energy conservation, the first operation (e.g., just filtering) is controlled in response to performance of the second operation (e.g., running a cleaner).

Aquatic applications will have a variety of different water demands depending upon the specific attributes of each aquatic application. Turning back to the aspect of the pump that is driven by the infinitely variable motor, it should be appreciated that precise sizing, adjustment, etc. for each application of the pump system for an aquatic application can thus be avoided. In many respects, the pump system is self adjusting to each application.

It is to be appreciated that the controller (e.g., **30** or **130**) may have various forms to accomplish the desired functions. In one example, the controller **30** includes a computer processor that operates a program. In the alternative, the program may be considered to be an algorithm. The program may be in the form of macros. Further, the program may be changeable, and the controller **30** is thus programable.

Also, it is to be appreciated that the physical appearance of the components of the system (e.g., **10** or **110**) may vary. As some examples of the components, attention is directed to FIGS. **6**-**8**. FIG. **6** is a perspective view of the pump unit **112** and the controller **130** for the system **110** shown in FIG. **2**. FIG. **7** is an exploded perspective view of some of the components of the pump unit **112**. FIG. **8** is a perspective view of the controller **130**.

It should be evident that this disclosure is by way of example and that various changes may be made by adding, modifying or eliminating details without departing from the scope of the teaching contained in this disclosure. As such it is to be appreciated that the person of ordinary skill in the art will perceive changes, modifications, and improvements to

the example disclosed herein. Such changes, modifications, and improvements are intended to be within the scope of the present invention.

What is claimed is:

1. A pumping system for at least one aquatic application, the pumping system comprising:

a pump;

a motor coupled to the pump;

a filter coupled to the pump; and

a controller in communication with the motor, the controller making a sensorless determination of a current value of at least one of pressure and flow rate based only on an input power to the motor, the controller using feedback to maintain the flow rate at a substantially constant value despite an increasing impediment caused by debris accumulating in the filter.

2. The pumping system of claim **1**, wherein the controller uses feedback to maintain the flow rate at the substantially constant value by increasing the pressure until the pressure reaches a maximum filter pressure.

3. The pumping system of claim **2**, wherein the controller uses feedback to maintain the pressure at a substantially constant value with a decreased flow rate after the pressure reaches the maximum filter pressure.

4. The pumping system of claim **1**, wherein the pressure is used to calculate a percentage of filter status.

5. The pumping system of claim **4**, wherein the controller generates a filter alarm and stops the pumping system when the percentage of filter status is about 100 percent.

6. The pumping system of claim **4**, wherein a backwash cycle is performed to reset the filter status.

7. The pumping system of claim **1**, wherein the controller obtains the input power from a hardware input in the form of at least one of a voltage and a current.

8. A pumping system for at least one aquatic application receiving inputs from a user, the pumping system comprising:

a pump;

a motor coupled to the pump;

a filter coupled to the pump; and

a controller in communication with the motor, the controller obtaining from a filter menu a total size of the at least one aquatic application as input by the user and a scheduled time including start and stop times for at least one cycle as input by the user, the controller calculating a filter flow value by dividing the total size by the scheduled time in order to self-adjust to any total size of the at least one aquatic application.

9. The pumping system of claim **8**, wherein the controller obtains from a filter menu at least one of cycles of circulation per day and turnovers per day in order to calculate the filter flow value.

10. The pumping system of claim **8**, wherein filter flow value includes different flow rates for different time periods of a day.

11. The pumping system of claim **8**, wherein the controller substantially continuously adjusts a speed of the motor to maintain an actual flow rate corresponding to the filter flow value.

12. A pumping system for at least one aquatic application, the pumping system comprising:

a pump;

a motor coupled to the pump; and

a controller in communication with the motor, the controller determining a current flow rate based on an input power to the motor, the controller determining whether the current flow rate is above a priming flow value in order to determine whether the pumping system is primed, the controller indicating a priming alarm if the pumping system is not primed before reaching a maximum priming time allotment.

13. A pumping system for at least one aquatic application, the pumping system comprising:

a pump;

a motor coupled to the pump; and

a controller in communication with the motor, the controller obtaining a hardware input including at least one of input power and motor speed, the controller calculating shaft power based on the hardware input, the controller determining priming status based on the shaft power, the controller indicating a priming dry alarm if the shaft power is at least approaching zero for at least about ten seconds.

14. A pumping system for at least one aquatic application, the pumping system comprising:

a pump;

a filter coupled to the pump;

a motor coupled to the pump; and

a controller in communication with the motor, the controller performing routine filtration cycles, the controller automatically at least one of reducing and eliminating at least one of the routine filtration cycles when other operations provide additional water movement to achieve a desired turnover rate.

15. The pumping system of claim **14**, wherein the other operations include at least one of a cleaning operation and a secondary filter operation.

16. The pumping system of claim **14**, wherein the routine filtration cycles are controlled in response to performance of the other operations.

* * * * *

CERTIFICATE OF SERVICE

I hereby certify that on this 4th day of May, 2015, a true and correct copy of the following: Opening Brief of Appellants Pentair Water Pool and Spa, Inc. and Danfoss Low Power Drives, was filed electronically using the court's CM/ECF system, which will automatically send e-mail notifications to all attorneys presently of record, and which will permit viewing and downloading of same from the ECF system.

Upon acceptance by the Court of the e-filed document, six paper copies will be filed with the Court within the time provided in the Court's rules.

Dated: May 4, 2015

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CERTIFICATION OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitations of Fed. R. App. P. 32(a)(7)(B). This brief contains 13,669 words, excluding the parts of the brief exempted by Fed. R. App. P. 32(a)(7)(B)(iii) and Fed. Cir. R. 32(b).

The undersigned further certifies that this brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type style requirements of Fed. R. App. P. 32(a)(6). This brief has been prepared in a proportionally spaced typeface using Microsoft Word 2010 in Times New Roman 14 point font.

Dated: May 4, 2015

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